Page

USACE, SCWA, and MCRRFCD will continue to implement many activities currently in place as described in Section 3, Environmental Baseline-Project. These agencies also propose modifications to existing operations to benefit listed salmonids within the Russian River watershed. The project will include both structural modifications to existing facilities and operational changes at the facilities.

This section focuses on the facilities and operations that would change relative to baseline conditions if the project is implemented. The project descriptions reference appropriate portions of Section 3 that will not change. This section is organized as follows.

Section 4.1 describes the modifications to flood control and the water storage facilities located at Lake Sonoma and Lake Mendocino. Operational changes include updates to the water control manuals, facility improvements at Warm Springs and Coyote Valley Dam for water supplies to fish production facilities, improved maintenance procedures during inspections and repairs.

Section 4.2 describes the modifications to the water diversion facilities at Mirabel and Wohler, and the transmission system that distributes the water. The descriptions of operations and maintenance identify changes intended to improve passage conditions at the diversions and minimize adverse effects to listed species.

Section 4.3, the flow management section, describes the proposed flow changes for the Russian River and Dry Creek (Flow Proposal). The objective of the Flow Proposal is to improve rearing conditions for salmonids in the Russian River, Dry Creek, and the Estuary. This section presents additional measures that SCWA is evaluating as part of the Flow Proposal. This section also describes the management of water levels in the Estuary with the goal of allowing the sandbar to remain closed during the summer months.

Section 4.4 describes the manner by which SCWA and MCRRFCD would conduct channel maintenance activities in the mainstem Russian River, constructed flood control channels, and tributaries. The proposed operations seek to balance habitat development and flood control.

Section 4.5 describes restoration actions that are being undertaken by SCWA since the signing of the MOU. These efforts include watershed management; riparian and aquatic habitat protection, restoration, and enhancement; and water conservation and recycling.

Section 4.6 describes the proposed operational and facility changes at the fish production facilities. The proposed operations implement a coho salmon conservation hatchery program, modify the steelhead mitigation program, and provide for a future Chinook salmon recovery program. The coho salmon program will function as an integrated recovery program and would include a captive broodstock program. The steelhead program would continue to be operated as an isolated harvest program under the existing production and release goals. No production of Chinook salmon is presently proposed; however, future monitoring may indicate that a Chinook salmon recovery program is warranted.

Section 4.7 identifies the agreements, permits, and other regulatory requirements that will require modification for the proposed project to be implemented. As discussed in Section 1.4, the proposed project is subject to a number of legal constraints and agreements. These agreements may constrain the extent to which, absent regulatory approvals and/or changes to the agreements, USACE and SCWA are able to implement conservation measures, reasonable and prudent measures, and conservation recommendations to be developed by NOAA Fisheries in the BO for the consultation. Therefore, implementation of the proposed changes may require modification or revision of the existing institutional agreements as well as compliance with NEPA and CEQA and other laws and regulations.

USACE and SCWA will also propose monitoring efforts to assess the effectiveness of the proposed actions on improving environmental conditions for listed salmonids, where appropriate. These will be developed in consultation with NOAA Fisheries and CDFG.

4.1 FLOOD CONTROL, WATER STORAGE, AND SUPPLY OPERATIONS

This section discusses proposed changes and upgrades to the physical components of the water storage and supply facilities.

Three major reservoir projects provide water supply storage for the Russian River watershed: Lake Pillsbury (Eel River), Lake Mendocino, and Lake Sonoma (Figure 2-1). Lake Pillsbury is part of the PVP, which is owned and operated by PG&E; its operations under the authorization of FERC are being addressed in a separate Section 7 Consultation between NOAA Fisheries and FERC (NMFS 2000a). Changes to the release criteria and minimum flow provisions in the 1983 FERC license for the PVP have been proposed by various parties, and are the subject of the BO from NOAA Fisheries and an EIS prepared by FERC. This BA does not propose any changes to the operation of the PVP, but incorporates in its analysis the PVID flow proposal evaluated by FERC in its BA.

4.1.1 COYOTE VALLEY DAM AND LAKE MENDOCINO

Lake Mendocino's water supply pool capacity is approximately 69,000 AF[1]. SCWA will continue to manage releases made from the water supply pool. USACE will manage releases when the water level rises above the top of the water supply pool (seasonally at elevations between 737.5 and 748 feet above MSL) and into the flood control pool (Figure 4-1). USACE will continue to manage releases during annual inspections and during maintenance and repair of the Coyote Valley Dam Project. Following formal

[1]All storage volumes discussed in this report are the 1985 bathymetric survey values reported by SCWA.

Figure 4-1 Coyote Valley Dam – Lake Mendocino Water Control Diagram

THIS PAGE INTENTIONALLY LEFT BLANK.

notification from USACE to SCWA of planned inspections or maintenance, SCWA will notify the SWRCB. USACE will notify NOAA Fisheries directly of the planned work. The Coyote Valley Dam facilities (and current operations) are described in Section 3.1.

4.1.1.1 Flood Control Operations of Coyote Valley Dam

USACE's primary objective for flood control releases from Lake Mendocino is to continue to prevent flood flows on the East Fork Russian River from contributing to overbank flood stages on the Russian River below Coyote Valley Dam. To the extent possible, USACE will limit releases from Lake Mendocino to prevent local flooding at Hopland, which generally occurs when flows in the Russian River exceed 8,000 cfs. Because bank sloughing is likely to occur when flows decrease too rapidly, USACE will limit the reduction in releases from Lake Mendocino to 1,000 cfs/h or less. Winter operations will include storage until the dedicated flood storage space is reached and flood control releases are made, as described below.

The specific criteria for Coyote Valley Dam flood control operations were revised in Exhibit A of the Water Control Manual (USACE 2003a). The general criteria for releases from the flood control pool, which includes all reservoir storage above the top of the water conservation pool, call for successively increasing releases in three stages as reservoir levels rise toward the emergency spillway. The operations provide for the greatest monthly reductions in lake level during late spring and early summer. When possible, releases from Coyote Valley Dam will be controlled so that flow at Hopland, approximately 14 miles downstream, does not exceed the 8,000-cfs channel capacity. However, maintaining flows of 8,000 cfs or lower at Hopland is not possible when inflow to Lake Mendocino is very high.

Specific directions for flood control operation are described by the Flood Control Diagram included in Exhibit A of the Water Control Manual, entitled "Standing Instructions to Damtenders" (Coyote Valley Dam Standing Instructions) as follows:

> *Flood Control Schedules 1, 2, and 3 releases are used to empty the flood control space following a storm. Under these schedules, releases will be limited to: (1) the discharge that does not cause the flow at the Russian River near Hopland to exceed 8,000 cfs, and (2) the discharge that results in flow at Hopland being less than that reached during the previous storm or storm series. The previous storm or storm series is defined as the event or events, which caused the highest pool at Lake Mendocino. In addition, releases will be limited to (1) up to 4,000 cfs if the reservoir pool did not reach elevation 746.0 feet, (2) 4,000 cfs if the highest reservoir pool reached was between elevation 746.0 feet and 755.0 feet, and (3) up to a maximum of 6,400 cfs if the pool exceeded elevation 755.0 feet. Releases will not be increased or decreased at a rate greater than 1,000 cfs per hour. Schedules 1, 2, and 3 are used if no significant rainfall is predicted.*

When the QPF is 1 inch or more for the next 24 hours or 1/2 inch or more for any 6-hour period in the next 24 hours, and releases exceed 1000 cfs, flows in the Russian River will be monitored, to ensure dam operations adhere to all other limitation and operating criteria. Also, when the flow in the Russian River at Ukiah exceeds 2,500 cfs and is rising, releases from Lake Mendocino will be reduced to 25 cfs, insofar as possible.

Outlet gates may be used for Flood Control Schedule 3 releases when the pool is above the spillway crest (elevation 764.8 feet); however, the sum of the spill and the releases must not exceed 6,400 cfs, subject to the above limitations.

The Emergency Release Schedule is used between elevation 764.7 feet and 773.0 feet, at which stage the flood control gates are fully opened. The flood control gates will remain fully open until the reservoir pool has receded to elevation 764.7 feet, at which time the release schedule 3 is implemented.

4.1.1.2 Coyote Valley Dam Maintenance and Inspection Activities

Annual and periodic (5-year) pre-flood inspections, as described in Section 3.1, would continue for the Coyote Valley Dam facilities. In the evaluation of the potential effects of maintenance and inspection activities, two issues arose: timing of inspections, and flow reduction during inspections and maintenance activities. To address these issues, structural modifications would be made at the dam, and changes in timing and operations during inspection and maintenance would be implemented.

Annual and periodic (5-year) inspections at Coyote Valley Dam typically require that flows through the dam cease for approximately 2 hours. Implementation of periodic maintenance or repairs identified during inspections may require flows through the dam to be reduced or shut down for longer periods, from 1 hour to several days. In the past during such inspections, the East Fork Russian River has been subjected to dewatering, and flows have been reduced in the Russian River downstream of the confluence with the East Fork.

To avoid dewatering the East Fork, USACE proposed to modify the Coyote Valley Dam facilities to allow a bypass flow of 25 cfs during inspection and maintenance. USACE is evaluating the installation of two pumps, approximately 250 hp each, to provide approximately 25-cfs flow in the East Fork Russian River. The bypass pumps would be attached to the outside of the control tower at Coyote Valley Dam and would draw water directly from the reservoir. The water would pass through a small pipeline and would be discharged downstream of the weir below the dam. USACE anticipates incorporating the bypass pipeline into the bridge to the control tower. The pumps will be operated as independent systems, thereby maintaining flow if one of the pumps fail. The pumps would remain operating during maintenance and inspection activities. This action would provide an uninterrupted flow of good quality water when the pumps are operating.

Construction of the bypass pipeline would provide a reliable water supply to the CVFF located at the base of the dam. A 15-cfs release from the bypass pipeline would be provided to supply water during maintenance activities or emergency repairs if the fish facility is in operation.

In 1998 and 1999, inspections at Coyote Valley Dam took place in September and June, respectively. In 2000, pre-flood inspection took place in May. During inspections, flows must be reduced or completely shut down. During previous inspections, flow interruption has affected young salmonids in the East Fork and the portion of the mainstem just below the confluence with the East Fork. To minimize the potential for routine maintenance and inspections to negatively affect salmonid fry, USACE will conduct such activities when young salmonid fry are not likely to be abundant. USACE proposes to schedule routine maintenance and inspection activities between July 15 and October 15. Shifting routine inspection and maintenance work to avoid May and June would allow the young salmonids in the reaches potentially affected to grow to a larger size so they are better able to avoid being stranded during declining flows.

4.1.1.3 Ramping Rates

Flows are ramped down during flood releases and in preparation for maintenance and inspection conducted in the summer and fall. USACE developed interim guidelines for flow release changes in consultation with NOAA Fisheries and CDFG described in Table 3-1. The evaluation of ramping rates for Coyote Valley Dam provided in *Interim Report 1* (ENTRIX, Inc. 2000a) indicated that protection of young salmonids could be improved if ramping rates for flows below 250 cfs were modified (ENTRIX, Inc. 2000a). Under the proposed operations, USACE proposes to modify the ramping schedule for Coyote Valley Dam and change the outlet structure to allow greater control over the gate opening. When releases from Coyote Valley Dam are less than 250 cfs, the ramping rates during decreasing releases would be reduced to 25 cfs/h (Table 4-1). To improve the ability to regulate flow changes of this level, USACE would install new automated controls to facilitate closing the outlet gates to meet the proposed ramping rates.

Table 4-1 Coyote Valley Dam Ramping Rates

Reservoir Outflow	Proposed Ramping Rates
0-250 cfs	25 cfs/h
250-1,000 cfs	250 cfs/h
>1,000 cfs	1,000 cfs/h

4.1.2 Warm Springs Dam and Lake Sonoma

Lake Sonoma is located at the confluence of Warm Springs Creek and Dry Creek, approximately 10 miles northwest of the City of Healdsburg (Figure 2-1). Existing Warm Springs Dam facilities are described in Section 3.2. The water control diagram for Lake Sonoma is presented in Figure 4-2.

4.1.2.1 Flood Control Operations of Warm Springs Dam

USACE will continue to determine water releases when the water level rises above the top of the water supply pool (an elevation of 451.1 feet above MSL) and into the flood control pool. USACE also manages releases during annual inspections and during maintenance and repair of the project. SCWA will continue to manage releases made from the water supply pool. To the extent possible, USACE limits releases from Lake Sonoma to restrict flows on the Russian River at Guerneville to 35,000 cfs, which is the approximate channel capacity in Guerneville. USACE also limits releases to prevent flooding downstream along Dry Creek, which generally occurs when flows just below the dam exceed 6,000 cfs. The criteria for flood control operation of Lake Sonoma are similar to those for Lake Mendocino, and were revised in the Warm Springs Dam Water Control Manual (USACE 2003b). Releases from the flood control pool include all reservoir storage higher than an elevation of 451.1 feet above MSL. As with Lake Mendocino, flood control includes three successive flood release schedules. For Lake Sonoma, the Hacienda Bridge gage, located approximately 16 miles downstream of Warm Springs Dam, is the most downstream monitoring point for decisions affecting flood control releases from Lake Sonoma.

Specific directions for flood control operation are described by the Flood Control Diagram included in Exhibit A of the Warm Springs Dam Water Control Manual, entitled "Standing Instructions to Damtenders" (Warm Springs Dam Standing Instructions) as follows:

> *Flood Control Schedule 1, 2, and 3 releases are used to empty the flood control space following a storm. Under these schedules, releases will be limited to: (1) the discharge that does not cause the flow at Dry Creek near Geyserville gage (Yoakim Bridge) to exceed 7,000 cfs and/or flow at the Russian River near Guerneville gage to exceed 35,000 cfs, and (2) the discharge that results in flow at Guerneville being less than that reached during the previous storm or storm series. The previous storm or storm series is defined as the event or events that caused the highest pool at Lake Sonoma. In addition, releases will be limited to a maximum of: (1) 2,000 cfs if the reservoir pool did not reach elevation 456.7 feet, (2) 4,000 cfs if the highest reservoir pool reached was between elevation 456.7 feet and 468.9 feet, and (3) 6,000 cfs if the pool exceeded elevation 468.9 feet. Releases will not be increased or decreased at a rate greater than 1,000 cfs per hour. When the pool elevation is at or below 502.0 feet and inflow is at or above 5,000 cfs no gate releases will be made. Schedules 1, 2, and 3 are used only if no significant rainfall is forecasted.*
>
> *Rain forecasts are considered significant when the QPF is 1 inch or more for the next 24 hours or ½ inch or more for any 6-hour period in the next 24 hours and releases exceed 1,000 cfs, flows in Dry Creek and the Russian River will be monitored hourly so that reductions in releases from Warm Springs Dam can be made to ensure dam operations will adhere to all other limitations and operating criteria.*

Figure 4-2 Warm Springs Dam – Lake Sonoma Water Control Diagram

THIS PAGE INTENTIONALLY LEFT BLANK.

Flood Control Schedule 3 releases will be maintained until elevation 502.0 feet is reached. This is done by regulation the outlet so that the combined flow from spills (pool above elevation 495.0 feet) and releases through the outlet works does not exceed 6,000 cfs.

The Emergency Release Schedule is used about elevation 502.0 feet (153.0 m) at elevation 505.0 feet (153.9 m) the flood control gates will be fully opened.

4.1.2.2 Water Supply to Fish Facilities

Several engineering options are being considered to provide a more consistent supply of water to the DCFH. The existing water supply pipeline could be replaced with an engineered pipeline incorporated into the wall of the flood control outlet works. Alternatively, a pipeline stub could be installed in the wet well, exiting the left abutment near the existing tunnel. This pipeline stub would allow water to be tapped directly from the wet well for hatchery supply, and for other future uses (e.g., hydroelectric operations, water supply).

Water released from Lake Sonoma can be taken from four different intake portals, each at a different elevation in the lake. Three intake portals are located in the left abutment of the dam, while the fourth portal is located near the bottom of the reservoir. Water from different portals will be mixed to optimize water temperature, DO levels, and turbidity. The selection of water intake levels will be determined by USACE in coordination with DCFH to meet the water quality needs of the fish production facility. This will control the water quality of releases to Dry Creek as well. With implementation of the Flow Proposal, there may be times when all of the flow released to Dry Creek will first flow through the fish production facility.

Under baseline conditions, the uppermost intake was plugged with concrete. The plug was removed in 2002 and the intake was flushed in 2003 (P. Pugner, pers. comm. 2003). Since this upper water discharge intake was repaired and cleaned, there has been more flexibility in meeting water quality requirements at the DCFH and in Dry Creek.

4.1.2.3 Maintenance and Inspection Activities

The maintenance and inspection activities at Warm Springs Dam, described in Section 3.2, would continue. The changes in timing and ramping rates described in Section 4.1.1.3 would be implemented for inspection at Warm Springs Dam. When releases from the dam are less than 250 cfs, they will be ramped down at 25 cfs/h or less. A bypass flow of 25 cfs will continue to be provided during maintenance and inspection activities.

4.1.2.4 Hydroelectric Operations

The hydroelectric facility operations are described in Section 3.2.4. The hydroelectric facility operates using water supply releases. The reductions in releases from Warm Springs Dam (as described in Section 4.3) would reduce the quantity of hydroelectric generation. The minimum operating flow for the facility is 70 cfs. Implementation of the

Flow Proposal would require the concurrence of FERC, and modifications to the terms and conditions of the FERC license for Project No. 3351-002 (see Section 4.7.2).

4.2 DIVERSION FACILITY OPERATIONS

4.2.1 DIVERSION FACILITY OPERATIONS

Under the proposed project, SCWA would continue to divert and deliver water to its customers through the water transmission system. SCWA's diversion facilities are located near Wohler and Mirabel, on SCWA property. SCWA operates five Ranney collector wells and seven conventional wells adjacent to the Russian River, which extract underflow from the aquifer beneath the streambed. A sixth Ranney collector well, located in the Wohler area, is expected to begin operation in 2004. SCWA operates five infiltration ponds near Mirabel and two infiltration ponds near Wohler. The ponds recharge the aquifer to create a reliable water supply to the Ranney collector wells.

4.2.1.1 Mirabel Diversion Facility Modifications and Operation

The Mirabel diversion facilities (located at RM 24.6), include an inflatable dam and concrete foundation, an intake structure equipped with two rotating fish screens, a pump caisson and control structure, conveyance piping, an outlet structure, and two Denil fish ladders at opposing sides of the river. These facilities are described in Section 3.3. *Interim Report 4* identified several areas where the Mirabel diversion facilities and operations could be improved (ENTRIX, Inc. 2001d). The operational changes would be associated with ramping rates during dam inflation and facility improvements to the fish screens, outlet, fish ladders, and inflatable dam. Modifications to the inflatable dam and diversion facility would be undertaken to reduce the potential for entrainment and impingement of listed species, and to speed outmigration of smolts.

Water Diversion Operations at Mirabel

Water diversion operations would generally continue according to previous practices. SCWA relies on the operation of the inflatable dam and the Mirabel and Wohler facilities to meet the water demand for water supplies. The inflatable dam will continue to be operated at the Mirabel diversion facility to raise the water level in the river, increase the rate of aquifer recharge, and facilitate the diversion of water into the infiltration ponds.

Inflatable Dam

Operations of the inflatable dam would continue as described in Section 3.3, with several modifications to improve passage of downstream migrants through the Mirabel diversion and to reduce the opportunity for stranding young salmonids either upstream or downstream of the dam as the facility is raised or lowered.

The inflatable dam is typically raised in May and lowered in October-November (Table 3-3). Depending on water supply conditions, the dam may be raised as early as March, and lowered as late as January. As demand increases under projected future demand, these facilities will be increasingly relied upon to meet peak demands in the spring and fall months as well as the summer period. When inflated, the dam impounds water for approximately 3.2 miles (5.1 km) upstream, creating the Wohler Pool. The increased pressure head and wetted area result in increased recharge to the underlying aquifer.

When the inflatable dam is raised, water levels below the structure can drop, potentially stranding juvenile fish in the channel downstream of the structure. Studies would be conducted to determine the operations at Mirabel that would be protective of juvenile salmonids in the channel affected by reduced flow levels. Monitoring would continue to be conducted during inflation and deflation of the dam to determine the most appropriate rate and to assess the risk of stranding on juvenile fish. The rate of flow reduction downstream of Mirabel would depend on the ability to regulate the inflation of the dam and on observations of stage changes and an assessment of stranding potential in the Russian River downstream of the dam. SCWA will evaluate the effects of ramping rates on downstream habitats and develop ramping criteria that are feasible and safe. Due to the potential for serious injury to dam operators or recreational users during inflation or deflation activities, the duration of these activities will be minimized.

The shape of the inflatable dam would be modified to reduce the risk of delay during downstream migration for juvenile salmonids. A single depression would be created in the crest of the Mirabel inflatable dam to concentrate the flow of water over the dam. This depression would be in place during juvenile salmonid outmigration periods, and would be maintained until smolt outmigration is complete (through June 15). The depression would then be removed and the dam raised to its full height to achieve maximum infiltration.

The depression will provide a localized point of discovery for fish trying to move over the dam. It will be created by filling the bladder to a base elevation with water and then introducing pressurized air into the bladder. The depression will provide a direct pathway for outmigrating juvenile salmonids to pass over the dam and move downstream, and thereby reduce potential downstream migration delay through the Mirabel facilities.

Intake Facility and Fish Protections

The Mirabel intake structure and fish screens are located on the west bank of the Russian River. They will be reconfigured to comply with NOAA Fisheries and CDFG criteria to provide a screen configuration that prevents impingement and entrainment of fry and juvenile salmonids. The modified intake structure would likely include flat plate screens and mechanisms for adjusting the relative magnitudes of the approach and sweeping velocities to enable fry and juveniles to swim past the screens and avoid impingement. The intake screen structure would be connected to the existing fish ladder downstream of the proposed screen bank. By directing both diversion flow and fish ladder flow through a single structure, the flows would produce sweeping velocities parallel to the screen face that meet NOAA Fisheries criteria. The combined flow would also make it easier for outmigrating smolts to find their way to the fish ladder. The proposed changes, including preliminary engineering drawings, are described in Borcalli & Associates (2001).

The modified intake structure would provide a transport velocity of approximately 2 fps at the upstream end and, with a minor deceleration over the length of the screen, would have a fish ladder exit velocity of 1.33 fps. These transport velocities would limit juvenile exposure time along the screen bank to less than 60 seconds.

The vertical plate fish screen panels would be integrated into the modified intake structure and fish ladder. The screens will be constructed of wedge-wire with a 50 percent open area. The screens would be cleaned using an electrically-operated, traveling brush system that traverses the entire screen bank in both directions. This operation would assist in transporting debris outside the limits of the screen array. The total screen surface area provided would be roughly 450 square feet, 25 percent greater than that required to satisfy the NOAA Fisheries' fish screen criteria for a maximum approach velocity of 0.33 fps. The additional surface area would provide a margin of safety to avoid violation of approach velocity criteria.

Articulating porosity control baffles would be installed in the modified intake structure immediately behind or downstream of the screen panels. The baffles would provide an adjustable means of velocity control with respect to individual, predetermined depth ranges to ensure that localized areas of high velocity would not occur at the screen face. The baffles would require a one-time adjustment and periodic cleaning. The baffle adjustment would be checked each time the dam is raised and inspected annually after the dam has been deflated.

Fish Ladders

The Denil-style fish ladders installed on each side of the dam will continue to be operated when the dam is raised (see Section 3.3). The fish ladder on the western side of the dam would be integrated into the diversion structure, as discussed in the preceding paragraphs.

Under previous operations, still water created at the upstream entrance to the east ladder may have inhibited the use of the ladder by outmigrating salmonids. Based on preliminary observations in 2002, it appears that the effect of the still water may be ameliorated by the depression in the center portion of the dam (D. Manning, pers. comm. 2003). However, if the still water behind the dam continues to create an impediment for downstream passage through this ladder, the upstream end of this fish ladder would be modified to direct outmigrating salmonids toward it. This would be accomplished by moving the upper end of the eastern fish ladder closer to the dam, or by installing a buoyed curtain to exclude juvenile salmonids from the pocket of still water that develops behind the dam. In addition, SCWA plans to modify the east-side bypass pipeline so that it can be operated at its 22-cfs capacity without creating turbulence at the mouth. The west-side bypass pipeline and fish ladder currently function properly.

4.2.1.2 Wohler Diversion Operations and Facilities Modification

The Wohler ponds are an important component of the aquifer recharge system. During part of the year, surface water would continue to be diverted into the two Wohler infiltration ponds to increase water production. The ponds can only be filled when the

Mirabel inflatable dam raises the river water surface. *Interim Report 4* identified the potential for listed salmonids migrating downstream to be entrained in the diversion to the Wohler ponds or entrapped in the ponds when the levees are overtopped during storm events (ENTRIX, Inc. 2001d). Modifications to the Wohler ponds would be completed to reduce potential entrapment or stranding of anadromous fish, and to prevent entrainment and impingement during the diversion season.

The Wohler diversion facilities consist of two ponds, each independently connected to the Russian River by earthen canals. These canals would continue to function as both inlet and outlet to the ponds. When the Mirabel inflatable dam is raised and the level of the river surface is increased, the ponds can be filled by opening the slide gates. Additional facilities would be constructed at Wohler to provide better protection against entrainment and stranding of listed salmonids in the infiltration ponds. Additional facilities include new intake structures and new fish screens. Modifications of facilities include recontouring of the ponds to reduce the opportunity for fish stranding and promote drainage to the river.

Since 1999, two interim measures have been implemented: 1) the culverts leading to the ponds are temporarily screened with 3/32-inch punch plates when the infiltration ponds are filled during the summer months, and the screens are removed when the Mirabel inflatable dam is lowered; and 2) Ponds 1 and 2 are graded to allow the water to drain back toward the inlet pipe as water levels recede. As a result of these interim measures, fish rescues have been concentrated in a much smaller area. Although fish rescues are sometimes still conducted, no fish rescues were required in 1999 or 2000. These interim measures would continue to be implemented until the Wohler intake structures and fish screens are modified.

Wohler Intake Structures

New, permanent, reinforced-concrete intake structures would be constructed at the terminus (river end) of the intake canals (Borcalli & Associates 2002). The intake structures would be constructed when the ponds are empty and prior to raising the inflatable dam. The intake structures would facilitate installing and removing the proposed screen modules (described below), and would allow for permanent attachment of the slide gates. The intake structures would be sized to accommodate the screen area required to meet screening criteria. They would be keyed into competent foundation material and would include riprap revetments to maintain stability and soil/structure integrity. The structures would include concrete decks to catch debris removed from the screen face and facilitate its removal and disposal. In addition, the decks would provide all-weather access for gate operation.

Fish Screens

Removable, pre-assembled, self-cleaning fish screen modules would be designed and installed in accordance with NOAA Fisheries and CDFG fish screen criteria. The screen modules could include a self-contained, stainless steel framework; electro-mechanical brush-cleaning systems; and a permanent support infrastructure attached to the intake structures for simple removal and installation. Since the Wohler diversion facilities are located at the ends of their respective side channels, and because there is no practical means of providing bypass flows, sweeping velocities would not exist at the faces of the screens. NOAA Fisheries' fish screen criteria sets forth minimum sweeping velocities; however, in cases such as this one where still water conditions exist, it is not possible to provide sweeping velocities. The screens would be sized to provide sufficient protection for fry and juvenile fish. The surface area of the screens would be increased (4 to 5 times the required area) to reduce approach velocities well below NOAA Fisheries criteria. These low approach velocities would make it easy for juvenile fish to avoid impingement on the screens.

Power to operate the screen-cleaning apparatus would be provided from the adjacent pump houses. The fish screens would be installed each year before raising the Mirabel inflatable dam. When the ponds are no longer needed to provide increased infiltration and the inflatable dam is lowered, the fish screens would be removed and the ponds drained.

Recontouring Wohler Ponds

One of the concerns associated with the Wohler ponds is the opportunity for salmonids to become trapped when winter storm flows overtop the levees. Under the proposed project, Wohler Ponds 1 and 2 would be regraded each year so that they have minimal residual volume when drained. The ponds would be regraded to drain towards the inlet pipe, thereby directing any fish present out of the pond. Interim measures completed in 1999 involved the regrading of Pond 2. Pond 1 was regraded in 2000. In addition, during the wet season, the slide gates to the ponds would be left fully open to allow water to drain from the ponds back to the river and to allow salmonids washed into the ponds to escape.

In the past, fish rescues have reduced the potential effects associated with entrapment. Fish rescue operations would continue by wading the ponds with beach seine nets after pond levels drop to a depth where wading is possible.

Regrading the ponds would reduce, but likely would not eliminate, the necessity of conducting fish rescue operations for juveniles. Furthermore, by limiting rescues to a smaller, shallow area, fish rescues could be conducted more effectively, reducing potential stress to fish. As a result of the regrading of Ponds 1 and 2 and improved interim fish screens, fish rescues were minimized during 2000 and 2001 (S. White, SCWA, pers. comm. 2002b). Fish rescues are still conducted in a small area that is lower in elevation than the outlet of the pond.

The Wohler ponds would need to be periodically regraded as part of normal maintenance activities. Maintenance would also be required to remove accumulated silt and debris to maintain infiltration rates and to ensure that the ponds drain properly.

Modification of Operations at Wohler Diversion Facilities

Operations at the Wohler Diversion Facility are described in Section 3.3. Changes in the operations would center around the new facilities described above and modifications to provide better protection for listed species. Operation and maintenance of the Wohler water diversion facilities would entail:

1. Annual preparation of the infiltration ponds and diversion facilities.
2. Annual removal and installation of the screen modules.
3. Maintenance of the screen modules, including cleaning and repair after removal.
4. Automatic screen cleaning operations at a user-selectable frequency.
5. Manual adjustment of the intake slide gates as needed throughout the infiltration season.

4.2.2 Transmission System Facilities

Existing diversion, distribution, and treatment facilities were presented in Section 3.3. Remaining authorized and proposed facilities are described here. Remaining authorized facilities are those that were authorized before approval of the WSTSP and are under construction or scheduled for construction in the near future. Remaining authorized facilities are needed to meet existing demand. Proposed facilities are those identified in the WSTSP that were proposed to serve future demands and expand the capacity of the existing water transmission system.

The proposed project analyzed in this BA includes both current water supply operations and potential future water supply operations that may be necessary to serve already-planned growth within the service area of SCWA's customers. In order to have some basis for evaluating the potential effects of future water supply operations, this BA assumes that SCWA will serve additional future water demands by constructing facilities and increasing diversions from the Russian River as contemplated by the WSTSP. Because of a recent Court of Appeals ruling on a lawsuit challenging the adequacy of the WSTSP EIR, SCWA must complete a supplemental environmental review of the program-level impacts of the WSTSP, and SCWA's Board of Directors must consider the impacts of that analysis when determining whether or not to re-approve the WSTSP. Thus, although it is uncertain whether the WSTSP will be carried out as described in the original EIR for the WSTSP, the inclusion of the proposed WSTSP in the present BA allows future effects to the threatened salmonid species to be evaluated based on more specific, defined assumptions than would otherwise be the case. The actual water supply facilities and diversions from the Russian River that SCWA's Board of Directors may approve in the future may differ from those contemplated by the WSTSP; nevertheless, the WSTSP provides a future project against which effects to salmonids from future water supply development may be analyzed. For this reason, the WSTSP is described and discussed in this BA, although the SCWA Board of Directors must reevaluate whether to approve the WSTSP after SCWA completes its supplemental environmental review.

4.2.3 THE WATER SUPPLY AND TRANSMISSION SYSTEM PROJECT

The three components of the WSTSP include: 1) implementation of water conservation measures that would result in the savings of approximately 6,600 AFY and expansion of the water education program; 2) increasing the amount of water diverted from the Russian River (a combination of rediversion of stored water and direct diversion of winter flow) by 26,000 AFY, thereby increasing the total amount of diversion and rediversion from 75,000 AFY to approximately 101,000 AFY; and 3) increasing the transmission system capacity by 57 mgd, thereby increasing the total capacity of the transmission system from 92 mgd to 149 mgd. Figure 4-3 illustrates conceptual locations of proposed facilities.

4.2.4 REMAINING DIVERSION FACILITIES

Facilities authorized prior to the WSTSP that remain to be completed to meet current demand include 20 mgd of standby pump and collector capacity. SCWA plans to achieve the additional 20 mgd of standby capacity in part through the operation of Collector No. 6, a Ranney-type collector well and pumphouse that is expected to commence operation in 2004. The construction of this facility underwent informal consultation with NOAA Fisheries in 1999 (NMFS 2000b). Ongoing operations and maintenance are addressed in this consultation. The Ranney collector and pumphouse will be similar to the existing Ranney collectors at SCWA's Mirabel diversion facilities.

4.2.4.1 Proposed WSTSP Diversion Facilities

Additional diversion facilities have been proposed for development in the general area of the Russian River watershed downstream of Lake Sonoma/Warm Springs Dam to meet future water demands. Diversion facilities may include additional Ranney-type collector wells, conventional wells, infiltration ponds, surface water diversion structures, water treatment facilities, pumps, connecting pipelines, and appurtenances. SCWA staff are reviewing the types and locations of diversion facilities that may be proposed. Brief descriptions are presented below and should be considered conceptual.

Ranney-Type Collector Wells (Collectors)

Collectors would be similar to those previously described for existing diversion facilities. Approximately four to six collectors would be constructed, operated, and maintained. Each collector would consist of a vertical concrete caisson with horizontal perforated intake pipes to collect naturally-filtered water from an aquifer associated with Dry Creek or the Russian River. At the top of the caisson would be a pumphouse with electric motors, pumps, and appurtenant controls for operation of the collector. Other appurtenances may include, but would not be limited to: connecting pipelines, access roads, observation wells, electrical equipment, radio telemetry equipment, water treatment (disinfection) equipment, and emergency power generators and associated fuel storage. If production capacity could be achieved via natural recharge to the aquifer, no additional diversion structures or infiltration ponds would be necessary; however, if

Figure 4-3 Sonoma County Water Agency Transmission System Facilities Existing and Proposed

THIS PAGE INTENTIONALLY LEFT BLANK.

artificial recharge is necessary, it is likely that additional infiltration ponds or diversion structures would be required.

Conventional Wells

The SCWA system presently includes three conventional wells at Occidental Road, Sebastopol Road, and Todd Road. Approximately 19 to 29 new production wells could be constructed, operated, and maintained, with a capacity of 2 to 3 mgd for each conventional well. Well depths would be approximately 100 feet. Each well would be equipped with submersible or vertical turbine pumps. Other appurtenances may include, but not be limited to: connecting pipelines, access roads, observation wells, electrical equipment, radio telemetry equipment, water treatment (disinfection) equipment, and emergency power generators and associated fuel storage. If production capacity could be achieved via natural recharge to the aquifer, no additional diversion structures or infiltration ponds would be necessary; however, if artificial recharge is necessary, it is likely that additional infiltration ponds or diversion structures would be required.

In 1998 and 1999, SCWA drilled and developed replacement wells at the Occidental Road and Sebastopol Road well sites to restore the original water production capacity of the wells. The loss in capacity was a result of the Occidental Road well screen having collapsed, and the Sebastopol Road well producing excessive amounts of sand. The two new wells at Occidental and Sebastopol roads and the existing well at Todd Road are completed to depths of 770, 1,040, and 805 feet, respectively. The three wells are capable of producing a combined total of approximately 5 to 7 mgd. In April 1999, at the request of SCWA, CDHS amended SCWA's domestic water supply permit to allow the Todd Road well to be used as an active, rather than a standby, source. The Sebastopol Road well was permitted as an active source in 2002.

Chlorine is added to the water produced at each of the three well sites to maintain protective residual levels of chlorine within the system and prevent contamination. Calcium hypochlorite is currently used at the Sebastopol Road and Todd Road well sites, eliminating the need for chlorine gas cylinders at the sites, and this system will be installed at the Occidental Road well in the future. In addition, a treatment system has been installed at the Todd Road well, which adds a small dose of an ortho-polyphosphate compound to the well water. The treatment was installed to determine whether it would be effective at eliminating the hydrogen sulfide odor, which frequently occurs in the water produced at all three wells. Although hydrogen sulfide does not affect the potability of the water, the odor it causes is a secondary water quality concern.

Surface Water Diversion and Water Treatment Plant

Additional diversion of surface water directly from Lake Sonoma, Dry Creek, and/or the Russian River would require construction, operation, and maintenance of a water treatment plant. A water treatment plant option was included in the WSTSP.

The treatment process would likely be a conventional treatment process, Actiflow (a new, patented, filtration system that uses micro sand to enhance sedimentation), or membrane filtration. Conventional treatment processes at the plant may include, but would not be limited to, rapid mixing, coagulation, flocculation-sedimentation, filtration, and disinfection. Facilities associated with the plant may include buildings, access roads, headworks, clarifiers, filters, storage ponds and/or tanks, raw water and finished water pipelines, electrical equipment, radio telemetry equipment, disinfection equipment, and emergency power generators and associated fuel storage. A facility to divert surface water to the treatment plant would also be included. Chemicals used in the treatment and/or disinfection processes may include, but would not be limited to alum, cationic and nonionic polymers, chlorine, and caustic soda.

4.2.4.2 Proposed WSTSP Distribution Facilities

Four major pipelines were contemplated as part of the WSTSP. Pipeline construction would involve the underground installation of approximately 229,000 lf of 18- to 60-inch-diameter, mortar-lined and coated, steel pipe and appurtenances. The four proposed pipeline routes would generally parallel existing water transmission pipelines (Figure 4-3). The actual pipeline routes have not been finally identified. The following paragraphs describe the four pipelines.

> *Mirabel-Cotati Pipeline*: The Mirabel-Cotati Pipeline would extend from SCWA's facilities in the Mirabel area and generally parallel the existing Russian River-Cotati Intertie pipeline for approximately 14 miles to Cotati. The pipeline would consist of approximately 72,000 lf of 36- to 54-inch-diameter pipe.
>
> *Cotati-Kastania Pipeline*: The Cotati-Kastania Pipeline would generally parallel a portion of the existing Petaluma Aqueduct for approximately 13 miles from the Cotati tanks to the southern end of Petaluma. The pipeline would consist of approximately 66,000 lf of 24- to 48-inch-diameter pipe.
>
> *Kawana-Ralphine Pipeline*: The Kawana-Ralphine Pipeline would connect with SCWA's Kawana Springs tanks site at the end of Kawana Springs Road in southeast Santa Rosa and extend approximately 5 miles in a northeasterly direction to connect with SCWA's Ralphine Tanks and the Sonoma Booster Pump Station. The pipeline would consist of approximately 26,000 lf of 30- to 36-inch-diameter pipe.
>
> *Annadel-Sonoma Pipeline*: The Annadel-Sonoma Pipeline would generally parallel the existing Sonoma Aqueduct for approximately 13 miles from the area of Pythian Road to the Sonoma Tanks. The pipeline would consist of approximately 65,000 lf of 18- to 24-inch-diameter pipeline.

The WSTSP contemplated an additional 55.5 million gallons of storage along the transmission system, increasing the existing storage from 118.8 million gallons to 174.3 million gallons. Three to five steel water storage tanks would be constructed, operated, and maintained to provide this additional water storage. Conceptual locations are shown in Figure 4-3. One of these tanks would be a second storage tank at the Kawana Springs location. The proposed site for this tank is adjacent to Kawana Springs Tank No. 1, approximately 0.75 mile east of the intersection of Kawana Springs Road and Petaluma Hill Road. One to three additional tanks could be located near the existing tanks just west of Cotati, and another tank could be located near the existing Kastania Tank, just south of Petaluma.

Two booster pump stations were proposed as part of the WSTSP. As with the proposed pipelines, the specific locations of the pump stations are in the process of being identified. Possible locations are shown in Figure 4-3. The booster pump stations are necessary to ensure that the full delivery potential of the expanded transmission system can be achieved. The two proposed booster pumps are conceptually described below.

> *Cotati-Kastania Booster Pump Station*: This booster pump station would be located along the Cotati-Kastania Pipeline. The pump size would be between 500 and 1,500 hp, and the size of the electrical substation would be between 500 and 1,700 KW. Storage for approximately 25,000 gallons of diesel fuel would be needed.
>
> *Sonoma Booster Pump Station Modification (Station No. 2, Pumps No. 2 and 3)*: This booster pump station would be a modification of the existing Sonoma Booster Pump Station No. 2, located near Spring Lake Park in east Santa Rosa. Two pumps, each approximately 250 hp, would be installed, and modifications to the existing electrical substation would be necessary to increase power by 500 KW. Existing diesel fuel storage at the site would be increased by 15,000 gallons.

Dechlorination for Accidental Spills

The pipelines in the SCWA water transmission system include valves, which may occasionally discharge potable water to various creeks and drainage swales or ditches. Potable water may also be discharged from tank overflow lines, although this occurs far less frequently. The maximum residual chlorine concentration in these discharges is approximately 0.6 to 0.7 parts per million (ppm). The volume of such a discharge is difficult to estimate, but is likely to be as much as several thousand gallons.

Dechlorination baskets have been added to each of the 17 valves that could result in a spill of potable water if they failed. The dechlorination baskets remove the chlorine from water that is accidentally spilled. An alert system has also been installed at each of these locations so that SCWA is immediately notified if there is a spill.

4.2.4.3 Proposed Treatment Facilities

As previously discussed, additional treatment facilities may be needed as part of the expansion of the transmission system to meet future demands. However, the specific type of facilities needed will depend on the type and location of diversion facilities that are ultimately selected.

4.3 FLOW AND ESTUARY MANAGEMENT

Management of instream flow in the Russian River system consists of two primary activities: winter flood control operations and summer water supply releases. Winter flood control operations are described in Section 4.1. Summer releases are presently determined by the D1610 instream flow requirements and water supply demands.

Under D1610, flows in the Russian River and Dry Creek must be augmented with releases from storage during the summer months. *Interim Report 3* reported that the augmented flows resulted in velocities exceeding the velocities for optimal rearing habitat (ENTRIX, Inc. 2002b). The intent of the proposed changes in instream flow management is to use the reservoirs and project facilities conjunctively to improve conditions for listed salmonids. Water releases from Coyote Valley Dam will be coordinated with water releases from Warm Springs Dam with the goals of: (1) meeting water supply needs; (2) improving rearing conditions for listed salmonids in the mainstem Russian River and in Dry Creek; and (3) reducing inflow into the Estuary during the dry season (June and September or October), allowing the Estuary to be operated as a closed system.

4.3.1 WATER DEMAND AND SUPPLY

SCWA would continue to divert, store, release, and redivert water within the Russian River basin under the terms of SCWA's appropriative water rights permits to meet present and future water demand as described in Section 3.3. SCWA is currently authorized to divert and redivert a total of up to 75,000 AFY from the Russian River, at a maximum rate of 180 cfs. The WSTSP (see Section 3.3) would provide a safe, economical, and reliable water supply to meet future needs in the SCWA service area. It would increase the transmission system capacity by 57 mgd, thereby increasing the total capacity of the transmission system from 92 mgd to 149 mgd. It would increase authorized diversions to 101,000 AFY, at a maximum rate of 230 cfs.

4.3.2 FLOW PROPOSAL

Under current D1610 operations, summer flow levels in Dry Creek and the Upper Russian River result in velocities that are too high for rearing salmonids (see Section 3.3 and ENTRIX, Inc. 2002b). Additionally, the cold water pool in Lake Mendocino is depleted prior to the end of the summer rearing period, which could result in stressful temperatures in the upper and middle Russian River for juvenile steelhead in the late summer and for Chinook migrating upstream. High summer flow into the Estuary creates the need for artificial breaching the sandbar at the mouth of the Russian River in the summer period. The proposed flow regime addresses these concerns. Specific objectives of the proposed flow modifications are to:

- Reduce velocities in Dry Creek and the upper Russian River in summer.
- Conserve the cold water pool in Lake Mendocino through the late summer.

- Provide for the exercise of existing water rights in the Russian River and Dry Creek.

- Enable SCWA to meet future transmission system demands arising from approved developments in SCWA's water contractors' service areas.

- Allow the sandbar at the mouth of the Russian River to be closed in the summer.

This section describes a Flow Proposal under consideration for implementation. An implementation plan and proposed permit terms are included in Appendix B for the proposed flow regime. Evaluations of the Flow Proposal and potential effects associated with its implementation are ongoing.

Winter flows in the Russian River and Dry Creek are the result of natural runoff from unregulated streams and flood control operations at Coyote Valley Dam and Warm Springs Dam. This Flow Proposal would not substantially alter winter flow management. Summer flows would be lower in the Russian River and Dry Creek, as would summer inflow to the Estuary. The proposed Estuary management is discussed in Section 4.3.3. The following discussion of the Flow Proposal focuses on summer (June to October) conditions. Flows are summarized for two cases: *all* water supply conditions, which combines the *normal*, *dry*, *dry spring*, and *critically dry* as defined by D1610; and *dry* water supply conditions, which describes the flows that occur during *dry* water supply conditions as defined by D1610. (Water supply conditions are defined in Section 3.4.1.)

4.3.2.1 Russian River between East Fork and Dry Creek Confluence

Flow releases to the Russian River between the East Fork and Dry Creek (upper and middle Russian River) would be managed to: provide suitable conditions in the Russian River for rearing salmonids during the summer months, to allow the Estuary to remain closed, to satisfy mainstem water rights, and to meet SCWA's water supply objectives at Wohler and Mirabel. This would be accomplished by coordinating the flow releases from Warm Springs Dam and Coyote Valley Dam. Minimum flow requirements at Healdsburg would range from 50 to 150 cfs during *normal*, *dry*, and *dry spring* water supply conditions for the portion of the river between the Forks and Dry Creek, with a minimum flow in the East Fork of 25 cfs at all times (Table 4-2). An exception to the *normal* flow requirements would occur if, anytime between November 1 through December 31, storage in Lake Mendocino fell below 30,000 acre-feet, then the required minimum flow rate would be reduced from 150 cfs to 75 cfs. During *dry* and *critically dry* water supply conditions, minimum required flows in the upper and middle Russian River would be reduced to 25 cfs. Summer flows in the upper and middle Russian River would usually exceed the minimum required flows in order to meet all water supply needs.

Table 4-2 Proposed Minimum Streamflow Requirements (cfs) for the Upper and Middle Russian River

Water Supply Condition	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Normal	150	150	150	100	100	50	50	50	50	50	150/75[1]	150/75[1]
Dry	75	75	75	75	75	50	50	50	50	50	75	75
Critically Dry	25	25	25	25	25	25	25	25	25	25	25	25
Dry Spring	150	150	150	100	100	50	50	50	50	50	75	75
East Fork	25	25	25	25	25	25	25	25	25	25	25	25

[1]75 cfs when storage in Lake Mendocino is less than 30,000 AF.

4.3.2.2 Russian River below Mirabel Inflatable Dam

Flows in the Russian River below the Mirabel Dam would be managed to avoid the need to breach the sandbar at the mouth of the Russian River during the summer. Minimum flows at the Hacienda gage would be the greater of 35 cfs or the "natural flow."

The "natural flow" of the lower Russian River is intended to mimic the flow in the lower river under predevelopment conditions. The implementation plan in Appendix B describes the process for determining the "natural flow." This flow scenario uses flows in Austin Creek or Maacama Creek to predict what the natural flow would be in the Russian River. The natural flow of the Russian River at Hacienda Bridge is defined as 11.77 times the 4-day running average of the gaged flow of Austin Creek (USGS Gage No. 11467200). During periods in which that gage is malfunctioning or otherwise not available, the natural flow is defined as 24.89 times the 4-day running average of the gaged flow in Maacama Creek at the USGS gaging station near Kellogg, California. Generally, natural flow would be the minimum flow during the summer months, but the required minimum flow would never be less than 35 cfs. In order to ensure that this minimum flow is met operationally, the minimum flow target would be 50 cfs. Releases from storage would be made to maintain the required minimum flow until flows naturally increase above a specified "transition flow" after which no additional water would be released from storage to maintain the "natural flow." The transition flow describes when natural runoff becomes the dominant factor determining flows and project operations are less important (Table 4-3). When the "natural flow" in the lower Russian River exceeds the transition flow rate, the required minimum instream flow would be the transition flow.

Table 4-3 Proposed Lower Russian River Transition Flow Rates (cfs)

Water Supply Condition	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Normal	125	125	125	150	150	125	125	125	125	125	125	125
Dry	125	125	125	150	150	125	125	125	125	125	125	125
Critically Dry	35	35	35	35	35	35	35	35	35	125	125	125

When the Estuary closes (typically between July and October), the minimum flows at Hacienda Bridge would be the lesser of the natural flow or the Optimal Estuary Inflow. The Optimal Estuary Inflow rate is the rate that would maintain the water surface elevation (WSE) at the Jenner gage at 7.0 feet. SCWA's preliminary analyses indicate that the inflow to the Estuary that will maintain a stable water surface elevation at this level is approximately 90 cfs at Hacienda. This level will avoid the local flooding that requires the sandbar to be breached periodically under current operations, and will allow the Estuary to remain closed. A closed system is expected to improve rearing habitat for salmonids in the lower part of the river.

4.3.2.3 Dry Creek

The minimum flow rates required under D1610 in Dry Creek would be modified so that the optimum range of flows for rearing coho salmon, steelhead, and Chinook salmon would normally be provided (Table 4-4). The optimum range of flows for rearing habitat is 30 to 70 cfs for steelhead fry and 30 to 90 cfs for coho salmon fry (Appendix C).

Table 4-4 Proposed Minimum Streamflow Requirements (cfs) for Dry Creek

	Month											
Water Supply Condition	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Normal	90	90	90	50	50	25	25	25	25	25	90	90
Dry	75	75	75	50	50	25	25	25	25	25	75	75
Critically Dry	75	75	75	50	50	25	25	25	25	25	75	75

Under the Flow Proposal, the flow requirements for Dry Creek would be modified so that under *normal* water supply conditions, flows during May through October would be managed at the mouth to provide suitable rearing flows. The Flow Proposal strives to provide the operational flexibility to meet short-term increases in water demand at Mirabel, and to manage the inflow to the Estuary. At buildout, summer releases from Lake Sonoma in excess of 90 cfs would be expected only during *critically dry* water supply conditions (approximately 2 percent of the summer periods). Releases from Lake Sonoma of this magnitude would be required to avoid dewatering Lake Mendocino. During *critically dry* water supply conditions, releases from Lake Mendocino would be reduced, and releases from Lake Sonoma would be increased to meet water demands at Mirabel. Minimum flow requirements in Dry Creek would range from 25 cfs in the summer months to 90 cfs in November and December.

4.3.2.4 Additional Measures

To maintain suitable rearing habitat for young salmonids as water demand increases in the future, SCWA would develop additional measures to meet the additional demand. These measures would minimize the need to release additional water into the Upper Russian River or Dry Creek during summer. The primary additional measures being considered are:

- An aquifer storage and recovery (ASR) program;
- A pipeline from Warm Springs Dam to the mouth of Dry Creek, the Wohler diversion facility, or a treatment plant; and
- Other storage facilities to be developed by SCWA.

SCWA may develop and implement a combination of these options, or others, in a phased manner as demand increases. While these measures are unnecessary under the existing demands, they will likely be necessary in the future. Future studies would need to be conducted to evaluate the feasibility of these concepts. The ASR and pipeline options are described on a conceptual basis below.

Aquifer Storage and Recovery

ASR is a method of water resource management utilized throughout the U.S. and the world that uses surface water supplies conjunctively with groundwater resources. For example, ASR is a water resource management strategy proposed by the CALFED Bay-Delta Authority. Conceptually, an ASR strategy would involve pumping water from SCWA's diversion facilities at the Russian River through the transmission system to groundwater recharge facilities in areas such as the Sonoma Valley, Santa Rosa Plain, or Petaluma Valley. This program would coordinate the timing of diversions from the Russian River to more closely match natural flow conditions. For example, relative to current practices, diversion of Russian River water would be increased when flows are naturally high in the winter and spring and reduced during the summer months when river flows are naturally low. Water diverted during the high flow (winter/spring) season would be stored in aquifers that are not contiguous with the Russian River. Water would be extracted from the storage in these off-river aquifers during the peak-demand (summer/early fall) season, thereby reducing the amount of water that would be diverted from the Russian River during periods of peak demand. This method of operation would allow lower flows to be maintained in Dry Creek and the upper Russian River during the summer.

Water would be diverted from the Russian River for aquifer storage during the wet season. Diversions from the Russian River would continue up to the allowable annual limits in SCWA's water rights permits. However, the timing of diversions would be modified as described above relative to current operations.

Additional diversion facilities may include Ranney-type collector wells, conventional wells, infiltration ponds, diversion structures, water treatment facilities, pumps, connecting pipelines, and related appurtenances.

ASR would improve operational flexibility and reliability as it would increase the diversity of supply sources available to meet demand and distribute these sources of water throughout Sonoma County. These supplies could be used to meet peak demands. The increased diversity of supply sources would also provide greater regional water supply reliability in the event of some catastrophic event that might impair the ability to divert and transport water from the Russian River. ASR would also reduce the number of diversion facilities along the Russian River that would be required to meet future water demands. The ASR concept would be studied further to determine its feasibility.

Pipeline

Another measure of reducing flows in the Russian River and Dry Creek is to construct a pipeline from Warm Springs Dam. This pipeline could terminate either at the mouth of Dry Creek, the Mirabel facilities, or at a treatment plant at a site to be determined. A new pipeline would likely be installed in the dam's wet well or outlet structure of Warm Springs Dam, or may require construction of a new outlet structure. To construct the pipeline, the Agency would need to obtain rights of way along Dry Creek and the Russian River. Releases from Warm Springs Dam to Dry Creek would remain in the range described for optimal salmonid rearing conditions. Any additional flow releases needed to meet water supply needs would be conveyed through the pipeline.

4.3.2.5 Modeling the Flow Proposal

Habitat conditions for listed salmonids under the Flow Proposal were evaluated using the RRSM and RRWQM models developed by SCWA. Model simulations were used to predict flow rates, temperature and DO levels in the Russian River and Dry Creek under the proposed management scenario. Simulations were run using the same hydrologic and meteorological constraints as those use to model flows under D1610. These constraints included known precipitation patterns, historical and projected future demand patterns, variations in climatic conditions, and local runoff levels in different areas of the watershed (Flugum 1996).

The models simulated a 90-year period on the Russian River, from 1910 to 2000. During model runs, each month is assigned to a water supply category (*normal*, *dry*, or *critically dry)* based on storage levels in Lakes Pillsbury and Mendocino (see Section 3.4.3). Simulations were conducted using two different water use scenarios, current and buildout demand levels. Current demand levels refer to the existing use of Russian River water required to supply urban and agricultural needs. Buildout demand levels reflects the maximum water demand that the WSTSP is designed to meet (Section 3.3.2).

Model output provides daily flow, temperature, and DO at specific locations (model nodes) along the Russian River and Dry Creek over the 90-year simulation period (Table 4-5). Habitat conditions for listed salmonids are assessed based on the distribution of these output values and their relative scores (as defined in Appendix C) for salmon species at different stages in their lifecycle (see Section 5.3 for details).

The Flow Proposal is expected to improve summer rearing conditions (June-October) for salmonids in the Russian River and Dry Creek relative to D1610. The Flow Proposal focused on this period, because this is the time of year when the project has the greatest effect on riverine conditions. This is also the time when conditions are most limiting for salmonids, because of warm water temperatures and reduced living space in the tributaries (the primary rearing habitat) due to low flows, and higher than optimal

Table 4-5 Median Flows (cfs) in the Russian River and Dry Creek for the Flow Proposal

Current Demand Level

***All* Water Supply Conditions**

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ukiah	744	928	516	604	290	187	163	160	143	127	174	387
Hopland	859	1088	625	684	312	184	152	150	137	124	177	424
Cloverdale	1084	1400	854	833	361	183	140	137	130	122	191	507
Healdsburg	1663	2181	1420	1193	501	181	119	128	126	141	227	664
Below Dry Creek	2086	3003	1985	1448	580	236	174	179	179	200	329	805
Hacienda	2692	3912	2677	1795	672	188	78	68	78	119	313	930
Warm Springs Dam	91	350	275	139	53	63	74	63	57	54	91	91
Lower Dry Creek	235	562	393	196	64	57	61	56	55	55	96	122

***Dry* Water Supply Conditions**

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ukiah	169	594	268	266	224	205	185	152	145	95	105	170
Hopland	189	665	349	286	229	194	170	145	138	94	109	184
Cloverdale	271	807	533	331	248	181	147	134	129	93	130	223
Healdsburg	466	1210	875	442	286	149	103	127	123	93	130	276
Below Dry Creek	594	1416	1077	517	338	208	169	178	175	148	210	374
Hacienda	767	1930	1511	596	327	123	52	65	71	57	169	408
Warm Springs Dam	76	76	76	51	51	71	83	63	58	56	78	76
Lower Dry Creek	110	150	148	71	58	60	69	57	55	56	80	96

Buildout Demand Level

***All* Water Supply Conditions**

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ukiah	726	913	512	599	298	191	205	160	146	137	177	371
Hopland	838	1081	617	677	315	185	192	149	140	135	180	407
Cloverdale	1075	1384	851	825	357	180	176	133	131	134	187	481
Healdsburg	1591	2127	1383	1172	478	178	151	120	124	134	190	602
Below Dry Creek	1992	2925	1954	1428	562	239	213	183	192	188	290	742
Hacienda	2577	3806	2577	1739	582	170	79	54	49	65	230	828
Warm Springs Dam	91	302	265	140	60	73	88	83	78	55	91	91
Lower Dry Creek	230	513	382	197	73	60	67	70	70	55	96	122

***Dry* Water Supply Conditions**

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ukiah	174	583	283	230	245	222	236	155	154	117	120	160
Hopland	190	645	365	257	237	207	214	145	145	116	124	177
Cloverdale	270	780	541	312	254	185	186	131	133	115	129	204
Healdsburg	419	1170	847	379	289	147	138	119	124	112	130	215
Below Dry Creek	553	1365	1048	459	352	219	210	182	192	177	209	312
Hacienda	681	1779	1443	492	268	110	53	50	45	49	125	302
Warm Springs Dam	76	76	76	51	56	83	101	83	82	65	78	76
Lower Dry Creek	110	150	150	72	63	66	78	70	73	65	80	97

velocities in the Russian River and Dry Creek. The predicted median flows provided by Flow Proposal under current and buildout conditions are described in the following two sections below.

Current Demand Levels

Under *all* water supply conditions, the Flow Proposal would provide median flows ranging from approximately 119 to 187 cfs in the middle and upper Russian River between June and October (Table 4-5). These flows generally provide highly suitable rearing conditions for young steelhead. Juvenile Chinook salmon are not affected by managed flows at this time of year as they have usually migrated out to sea by July. Coho salmon are also not affected by these flows, as they generally rear in the tributaries. Flows tend to be slightly lower during the late summer and fall months in the lower portion of the mainstem (Hacienda Bridge); however, this has little impact on steelhead since they mostly rear in the middle and upper Russian River.

Under *dry* water supply conditions, the Flow Proposal would provide median flows ranging from 103 to 205 cfs in the middle and upper Russian River between June and October. Flows above Healdsburg are predicted to be higher in the summer (June and July) compared to *all* water supply conditions, and slightly lower in October. Flow rates decrease moving downstream from Healdsburg, ranging from about 57 to 123 cfs at the Hacienda.

During the rest of the year, flow rates increase from November to February and then decrease through the spring (May 31). Flows during this time of year are largely due to natural runoff and seasonal rains rather than dam operations on the Russian River. In the upper mainstem (Ukiah) median monthly flows range from about 170 cfs (November) to 925 cfs (February), under *all* water supply conditions, and from 95 to 595 cfs under *dry* water supply conditions. In general, monthly flow rates increase as you move downstream from Ukiah, with the highest flows occurring at Hacienda Bridge. These flow conditions coincide with upstream migration, spawning, and incubation life stages of all three listed species.

In Dry Creek, median flows for June through October are predicted to range from about 55 to 75 cfs, for *all* and *dry* water supply conditions. Flows during this time period are similar throughout the entire reach. The low flows provided by the Flow Proposal in the summer and fall are expected to improve rearing conditions for juvenile coho salmon (should populations increase in this reach) and steelhead within Dry Creek. Median flow conditions are predicted to be fairly similar between current and buildout demand levels. Under *critically dry* water supply conditions, which occur about 2 percent of the time during the summer months, flows would range from 94 to 148 cfs from June through October. While higher than optimal, these flows would still be substantially lower than those occurring under D1610 under even *dry* water supply conditions (which occur about 15 percent of the time).

During November through May, flows in Dry Creek under *all* water supply conditions would range from about 90 to 300 cfs. The lowest flows would occur in November through January, while February would have the highest flows. In *dry* water supply conditions, flows would be much lower and more constant at about 75 cfs from January through March and 50 cfs in April and May.

Buildout Demand Levels

To maintain the improved conditions that this Flow Proposal would create for salmonids as water demands increase in the future, SCWA will develop and implement one or more additional measures to allow flows to remain near the levels described above. The primary measures being considered are: an aquifer storage and recovery (ASR) program; a pipeline from Warm Springs Dam to the mouth of Dry Creek, the Wohler diversion facility, or a treatment plant; and additional storage facilities (see following section).

Under this Flow Proposal, flows in the middle and upper Russian River are anticipated to remain stable over time as water supply demand increases. Median flows in Dry Creek are anticipated to increase slightly under the future demand scenario (relative to existing demand), but would remain within the range of suitable flows for salmonid rearing. Flows at Hacienda are expected to be similar to those under existing demands in the summer months. It is anticipated that the Estuary could be managed as a closed system from July through October under both current and future water supply demands.

Flows under buildout demand levels were modeled assuming that additional measures would be implemented to maintain suitable rearing flows under future water demands. During June through October, median flows in the middle and upper Russian River (Healdsburg to Ukiah) would range from approximately 120 to 205 cfs under *all* water supply conditions and from 112 to 236 cfs under *dry* water supply conditions. Flows in these ranges would provide good to optimal rearing conditions for juvenile steelhead.

Median flows in the lower Russian River (Hacienda Bridge) are reduced relative to those in the upper mainstem. In general, flows are the same under *all* and *dry* water supply conditions, ranging from about 45 to 110 cfs, except in June, when median flows are 60 cfs higher under *all* water supply conditions (160 cfs). Steelhead do not usually rear in this region of the Russian River, however, median flow conditions are expected to remain highly suitable for juveniles. During the rest of the year, flow rates increase from November to February and are similar to current demand levels. Flows are higher under *all* water supply conditions ranging form 177 cfs (Ukiah in November) to 3806 cfs (Hacienda Bridge in February), compared to a range of 120 to 1779 cfs under *dry* water supply conditions.

Under Buildout demand in Dry Creek, median flows between June and October are similar throughout the upper and lower reaches. Under *all* water supply conditions, flows are predicted to range from 55 and 83 cfs, and should provide excellent to optimal rearing conditions for coho salmon and steelhead.

Under *dry* water supply conditions, median flows are about 10 to 20 cfs higher, ranging form 63 to 101 cfs during the summer months. These flows are still expected to provide good to excellent rearing conditions for juvenile salmonids, except in July, when flows may be somewhat stressful. At buildout demand levels under *critically dry* water supply conditions, which occur about 2 percent of the time during the summer months, flows would range from 139 to 200 cfs from June through October. These flows would be lower than under *dry* water supply conditions for D1610. *Dry* water supply conditions occur about seven times more frequently than *critically dry* water supply conditions.

During November through May, flows in Dry Creek would be similar to those under existing demand levels for both *all* and *dry* water supply conditions.

4.3.3 Estuary Management

The objective of the Estuary management proposal is to improve habitat for listed salmonid species while preventing flooding of local properties. To improve summer rearing habitat in the Estuary, the proposed project would eliminate artificial breaching of the sandbar during the summer months. Artificial breaching may be required in the spring or fall, and in some dry winters, to manage storm flow inflows to the Estuary to prevent flooding of local property.

Estuaries and lagoons in the Central California Coast and Northern California Steelhead ESUs provide important summer rearing habitat for steelhead and Chinook salmon (Anderson 1995, 1998, 1999; Cannata 1998; Larson 1987; Smith 1990). Summertime breaching of sandbars has been found to severely alter steelhead habitat conditions in lagoons (Smith 1990), and summertime breaching can negatively affect salmonids (Anderson 1995, Smith 1990). Infrequent artificial breaching, especially during low-flow summer months, impairs water quality because salinity stratification repeatedly results in periods of higher water temperatures and low DO levels (Smith 1990; MSC 1997a, 1997b, 1998, 2000; SCWA 2001b). Fluctuations in temperature, DO, and salinity affect salmonid habitat, primary production, and the abundance of aquatic invertebrates upon which young salmonids feed (Smith 1990). Smith (1990) found that when a sandbar is left closed over the summer months, good water quality develops when the system is converted to fresh water, and stable habitat conditions form. Habitat conditions for salmonids in the Estuary would be improved by eliminating artificial breaching in the summer.

Under the proposed action, there would be two management scenarios, one for Low-flow Estuary Management and one for Storm-flow Estuary Management. The Estuary would be managed with the goal of maintaining a closed system (lagoon) with freshwater habitat during the low-flow (summer) season. This action is expected to improve summer rearing habitat by allowing the lagoon to freshen and by stabilizing salinity and dissolved oxygen conditions, which would also increase and stabilize the invertebrate food base for salmonids. The frequency of breaching and the amount of freshwater inflow are two major factors that influence water quality in a lagoon or estuary system. Under the Flow Proposal, flow to the Estuary would be low enough to avoid artificial breaching in the summer, but high to freshen the lagoon after the sandbar first closes. Under Storm-flow Estuary Management, artificial breaching would be conducted to manage the Estuary as an open system during the wet season to minimize flooding of local property.

Under D1610, the Estuary cannot be managed as a closed system during *normal* water supply conditions because required minimum flows at Hacienda provide inflow rates to the Estuary that are too high to avoid flooding if the sandbar is not breached. Therefore, the proposed Estuary management action could only be implemented in concert with reduced flows such as those in the Flow Proposal. Implementation of the Flow Proposal allows dry season inflow to the Estuary to be substantially lower than permitted under D1610.

4.3.3.1 Low-Flow Estuary Management

Once the sandbar forms across the river mouth at the end of the wet season, flow in the Russian River to the Estuary would be managed to maintain a WSE of approximately 7.0 feet or less as recorded on the Jenner gage, but may vary from 6.0 to 8.0 ft during the low flow period when the sandbar first closes, WSE may initially be approximately 4.5 ft). This would eliminate the need to artificially breach the sandbar that forms across the river mouth during the dry season. Under this scenario, the system would be managed as a lagoon (sandbar closed). Based on an analysis of the relationship between flow at the Hacienda gage and stage change at Jenner, a preliminary estimate of the flow at which a stable WSE of 7.0 feet would be maintained (when inflow and outflow through the sandbar are equal) is approximately 90 cfs (estimated range of 50 to 100 cfs) (C. Murray, SCWA, pers. comm. 2003).

Under the Flow Proposal, required minimum flow rates in the Russian River (at Hacienda Bridge) during the spring-summer transition would track the natural flow, calculated using flows in Austin Creek or Maacama Creek, until the natural flow rate declines below the floor value of 35 cfs, where the minimum flow rate remains until the natural flow rate increases above 35 cfs, then the natural flow would again be the required minimum flow (See Appendix B). The Estuary WSE that would result from these flow rates would be approximately 7.0 feet when the lagoon first closes, but would likely vary from 8.0 feet in the early summer to approximately 6.0 feet, generally later in the summer.

4.3.3.2 Storm-Flow Estuary Management

Artificial breaching of the sandbar across the mouth of the Russian River would still be required to manage storm flows and prevent flooding to private property and roads. Inundation of property begins at a WSE of approximately 10 feet, but the sandbar closing the mouth can reach elevations above 15 feet (RREITF 1994). Because the sandbar would generally be artificially breached when a storm approaches, it is unlikely that the WSE in the lagoon would exceed 8 feet. Repeated breaching would be implemented if inflow is insufficient to maintain an open mouth, but high enough to cause flooding. Repeated breaching may be necessary in dry winters.

Two basic categories of breaching events, early season and late season, are based on their potential to affect water quality in the Estuary or in a lagoon environment.

Early Season Breach Events

Early season artificial breach events are defined as those that would occur at the onset of the rainy season in the fall. If storms did not occur earlier, the sandbar would likely be opened in mid-October when USACE begins to release water from Lakes Mendocino and Sonoma to bring these reservoirs down to flood control levels for the winter. Artificial breaching would be conducted as close as is practical to the time that a natural breach would occur, but would be implemented before WSE exceeds a target of 8 feet, although actual WSE may be slightly higher than this target. The timing of natural sandbar breaching is variable and depends on local weather patterns, ocean conditions, runoff from the Russian River basin, and inflow to the lagoon.

Artificial breaching would be undertaken when an imminent threat of flooding exists, or when the WSE of the lagoon, as recorded at the Jenner gage, is rising at a rate that indicates it will reach the 10-foot flooding elevation within 48 hours. The timing of the breaching activity would be conducted earlier if work conditions pose safety risks to crews. The objective of this protocol is to time the artificial breaching as close as possible to the time that natural breaching would occur without undue risk to personnel or equipment.

Late Season Breach Events

Late season breach events are defined as those that occur near or after the end of the rainy season. Because late season breachings during low-flow periods can be an important factor in summer water quality conditions, they will be minimized to the extent practical. Late season breaches will only be conducted if runoff from a rainfall event is likely to result at a WSE greater than 8.0 feet. It is expected that, with an initial target WSE of approximately 7.0 feet at the Jenner gage, there would be sufficient inflow for rapid conversion to freshwater conditions.

Breaching Protocols

Heavy equipment for breaching would be restricted to the beach area, and staging would take place away from water. The equipment would be brought to the breaching area over the shortest route possible. The sandbar would be breached north of the jetty, at least 150 feet from the oceanside point of the jetty.

Following the decision to breach, 2 full days are required to mobilize equipment and issue notifications. Sandbar breaching can take from 1 to 10 hours. Initial breaching of the sandbar would normally be completed using a bulldozer or similar equipment. The shortest distance between the lagoon and the ocean would be selected as the breaching location so that a minimum amount of sand would be moved. A plot channel would be dug between the ocean and the lagoon, leaving a narrow sand berm between the breaching channel and lagoon. This berm would extend the width of the excavated channel, and be wide enough to retain water within the lagoon. A bulldozer would shape a channel by pushing sand to the north and south of the breach area until the bottom of the channel is level with the lagoon WSE. A bulldozer would then remove the narrow sand berm with a final pass.

The erosive force of the water that runs from the lagoon through the pilot channel will widen and deepen the channel, creating a large outflow channel across the breach within a few hours. By the time water has drained from the Estuary, the channel may be approximately 100 feet wide. Because inflow can exceed initial breaching outflow, the lagoon may continue to rise after initial breaching, and outflow and inflow may balance after a number of hours.

The excavated sand would be placed on the beach. The surf would rework the sand during the subsequent few days. In the winter, steep, high-frequency waves tend to move sand from the beach to an offshore bar. In the summer, the waves are smaller and farther apart, and move the sand from the sandbar back to the beach.

4.4 CHANNEL MAINTENANCE

SCWA would continue to conduct channel maintenance activities in the Russian River and its tributaries to reduce the potential for flooding and erosion. SCWA's actions include:

- Flood control and bank erosion control in the Mark West Creek watershed.
- Flood control in the Central Sonoma Watershed Project.
- Activities related to Coyote Valley Dam and Warm Springs Dam.
- Streambank erosion control in the Russian River.
- Emergency actions in natural channels.

Some of the proposed activities are sediment maintenance, channel debris clearing, vegetation maintenance, bank stabilization, Additionally, top-of-bank landscape and structure maintenance, and storm-drain outfall maintenance are performed. An overview of baseline conditions and practices in these categories is provided in Section 3.6. The following proposed modifications to channel maintenance activities are described in this section.

- Channel maintenance within the Central Sonoma Watershed Project and Mark West Creek watershed.
- Russian River
    - Channel maintenance related to the construction and operation of Coyote Valley Dam.
    - Channel maintenance related to USACE-identified and USACE-constructed flood and erosion control sites (federal sites).
    - Channel maintenance related to Public Law 84-99 sites (nonfederal sites).

- Debris removal as necessary to protect life and property.

- Dry Creek channel maintenance related to the construction and operation of Warm Springs Dam (federal sites and one Public Law 84-99 nonfederal levee).

- NPDES stormwater discharge permit activities.

Channel maintenance would be conducted as a cooperative effort between SCWA operation and maintenance staff and biologists to achieve both flood control and aquatic and riparian habitat objectives. Channel maintenance would be conducted in accordance with SWRCB WDR 81-73. SCWA would comply with the BMPs described in the San Francisco Bay Area Stormwater Management Agencies Association's *Flood Control Facility Maintenance Best Management Practices – A Manual for Minimizing Environmental Impacts from Stream and Channel Maintenance Activities*.

MCRRFCD would continue to conduct channel maintenance activities related to the CVDP in Mendocino County. This includes maintenance of federal sites and inspections of Public Law 84-99 sites. MCRRFCD would also conduct activities related to streambank stabilization in the mainstem Russian River.

SCWA would also perform channel maintenance activities on channels in the Russian River watershed that have undergone restoration activities. For example, SCWA has entered into an agreement with the City of Santa Rosa regarding maintenance of portions of Santa Rosa Creek upon completion of the City of Santa Rosa's Prince Memorial Greenway project.

SCWA would perform channel maintenance activities for certain natural channels, constructed flood control channels, and those flood control channels that have been modified to provide increased habitat value for fish and wildlife species.

The following sections describe channel maintenance activities for sediment maintenance, channel debris clearing, vegetation maintenance, and bank stabilization. Channel maintenance activities in constructed flood control channels differ from those in natural waterways, and are discussed separately. In addition, channel maintenance activities in Dry Creek and the Russian River are discussed separately from other activities in natural waterways.

Infiltration capacity at the Wohler and Mirabel diversion facilities would be augmented by periodically recontouring gravel bars in the Russian River upstream of the inflatable dam and also downstream of the inflatable dam near the Mirabel/Wohler infiltration ponds.

4.4.1 Sediment Removal and Channel Debris Clearing

Sediment buildup in flood control channels can reduce the capacity of the channels and reduce the level of flood protection. Sediment removal and vegetation removal activities are necessary to maintain channel capacity and control streambank erosion. SCWA would continue to conduct channel maintenance activities on more than 300 miles of streams within Sonoma County, most of which are located in the Russian River watershed, including both constructed flood control channels and natural waterways (Tables 3-12 and 3-14, respectively). Sediment removal would be done as-needed in constructed flood control channels. Occasionally, emergency sediment and debris removal would be conducted on natural waterways in response to an event such as a large storm, as defined under USACE nationwide permits.

4.4.1.1 Constructed Flood Control Channels

Sediment and debris removal and vegetation maintenance would be conducted to maintain flood capacity of constructed flood control channels. Excessive sediments tend to be deposited at locations where the channel gradient significantly decreases, such as along Hinebaugh and Copeland creeks, and as the channel traverses from the steep gradient headwaters on Sonoma Mountain to the low-gradient valley plain in Cotati and Rohnert Park. Sediment removal would be conducted on an as-needed basis.

Streams would be scheduled for sediment removal when field inspections indicate that the invert elevation of outfall structures is generally less than 12 inches above the streambed elevation. Sediment removal would be performed during summer or fall months until October 31. Only segments of the channel reach that inspections determine have become hydraulically impaired would have sediment removed. Sediment removal would consist of excavation of bars that have accumulated bed material and become enlarged by deposition over time.

The bars tend to create a meandering, sinuous pattern along the low-flow channel bottom. The bars effectively create a narrower channel bottom so that the low-flow channel has greater depth for a given flow than without the bar deposits. This improves fish passage for both upstream adult migration and outmigration by juvenile steelhead.

SCWA would evaluate the feasibility of actions that maintain a low-flow channel as part of the sediment removal work, and implement those actions in channels where it has the potential to improve availability of quality habitat without compromising flood control capacity. Channels that require more frequent or aggressive maintenance and that provide access to upstream spawning or rearing habitat will reap maximum biological benefit.

The goal is to maintain some low-flow channel sinuosity that provides better depths for migration following sediment maintenance. One option is to lower the height of the bar deposits by excavation, but leave a portion of the deposit in place above the channel design invert, and excavate a low-flow channel. This could result in the need for more frequent sediment maintenance activities to maintain channel capacity, but would improve water depths for fish passage.

4.4.1.2 Natural Waterways

SCWA would not perform routine sediment removal activities in natural waterways. SCWA has hydraulic maintenance easements that are permissive and SCWA would continue to access various natural creeks to remove debris or vegetation to restore hydraulic capacity (Table 3-14).

Two- to four-person crews would clear brush by hand with chainsaws and loppers. In heavy brush, a chipper would be used to break up the slash so that it can be disposed of, rather than leaving it to decay in the stream. Larger material would be cut into shorter lengths and removed from the site. Woody material would be cut up and pulled out by a truck with a winch. Trees and limbs would be removed from the stream channel only if required for flood protection.

While planting native vegetation would not be a standard practice during channel maintenance activities, occasionally native tree planting projects by volunteer groups would be coordinated or permitted by SCWA. SCWA and CDFG have implemented riparian enhancement projects to increase canopy cover, and these are discussed in Section 4.5.

Occasionally, emergency sediment and debris removal would be conducted on natural channels, including the Russian River. This would usually occur in response to an event such as a large storm that produces situations where channel flood capacity is diminished and streambanks are threatened or damaged (discussed in Section 3.6).

SCWA has developed BMPs and other guidelines for planning and implementing sediment removal and bank stabilization work performed in natural waterways to protect listed species and to minimize the potential for significant habitat alterations. SCWA would continue to use the BMP and guidelines summarized below:

- Sediment removal and bank stabilization projects are not to exceed 1,000 feet in length for any single project.

- Projects that are within 1,000 feet of a previously armored site are not implemented.

- Construction occurs during the summer to avoid spawning and incubation periods.

- A qualified fisheries biologist consults on the project design prior to implementation to consider all feasible alternatives. Habitat and biological resources in the area are evaluated.

- Projects are developed in consultation with CDFG.

- Bio-engineering bank stabilization methods are given priority where they will provide effective erosion control.

- Where bio-engineering bank stabilization methods are not deemed to be practical, then priority is given to incorporating vegetative plantings into the hard-armoring techniques that are implemented.

- Fish habitat restoration elements (such as native material revetments) are incorporated into bank stabilization practices where they are feasible with the intention of replacing lost habitat.

If large woody debris is present in excavated sediments, then it is removed from the channel only if it threatens to de-stabilize a section of streambank.

4.4.1.3 Flood Control Reservoirs

Flood control reservoirs are designed to impound water during the rainy season to reduce the potential for flooding in downstream urbanizing areas. Brush Creek Reservoir (137-AF capacity), Piner Creek Reservoir (175-AF capacity), and Spring Creek diversion (negligible capacity) are relatively small reservoirs that dry up by the summer (B. Oller, SCWA, pers. comm. 2001). Matanzas and Spring Lake reservoirs have larger capacities (1,525 AF and 3,550 AF, respectively) and do not dry up during the summer nor do they spill downstream during the summer season. Spring Lake is located offstream and continuously holds water. The Sonoma County Park Department adds water (after October when peak water demands are reduced) to maintain a recreational lake. A small tributary spring at the Spring Lake diversion facility also feeds water to Spring Lake.

SCWA flood control reservoirs would continue to be operated as described in Section 3.6.1. Maintenance activities include desiltation and removal of noxious pondweeds. Desiltation, debris removal, and vegetation removal would also be performed at the inlets and outfalls to the reservoirs. Sediments would be excavated to restore the flood control capacity.

Sediment would be removed as needed in the flood control reservoirs maintained by SCWA (i.e., Spring Lake, Brush Creek, Paulin Creek, Matanzas Creek, and Spring Creek diversion facility). Sediment excavation would be performed either when the reservoir is dry, or when there is no flow out from the reservoir. Matanzas, Spring Lake, and Piner reservoirs would be drained before sediment removal activities. The frequency of this maintenance would vary, depending on the reservoir and the level of sediment that has accumulated, but could be from every 3 to 10 years. Vegetation removal at the outfall of the reservoirs could occur annually, if needed.

At Spring Lake, approximately 1,000 cubic yards of sediment (mostly sand and silt rather than coarse sediments) would be removed from the inlet channel about once every 5 years, especially after a large flood event. The inlet channel that drains into the lake captures sediment before it enters the lake so that frequent desiltation of Spring Lake is not necessary. A weir keeps most of the coarse sediments out of the basin. Spring Lake was drained and bulldozed in 1985 to remove hydrilla (an aquatic noxious weed), and this may be done in the future if needed.

Spring Lake differs from the other reservoirs in that it holds significantly more water through the summer. The lake covers a large area, but has an average depth of only about 15 feet. There are two outlets to Santa Rosa Creek, a 6-foot wide by 8-foot deep outlet structure that carries the primary flow during flood events, and a principal spillway that carries any excess water. Before removal of hydrilla and any needed desiltation, the lake would be dewatered by pumping to Santa Rosa Creek. Screening during the dewatering process prevents the release of predators from the lake. Fish rescues would be conducted and salmonids released to the stream. When Spring Lake is drained for maintenance work, it would be drained as early as possible in the spring, typically in April, before lake waters become very warm, to avoid increasing water temperatures in Santa Rosa Creek (the recipient of water from Spring Lake). Dewatering may take 4 to 6 weeks, with maintenance occurring after the lake is drained. This work would be performed every 15 years. The reservoir would be partially filled with dechlorinated potable water by Sonoma County Regional Parks to maintain a recreational lake. Sediments would also be removed at the Santa Rosa Creek intake structure of Spring Lake. This structure contains barriers and silt deflection structures to reduce the amount of material that goes from Santa Rosa Creek to Spring Lake. Sediments would be excavated from detention basins in the summer when the inlet is dry.

In Matanzas Creek Reservoir, the desiltation would begin in the late spring or summer, after inflows have stopped and the reservoir has dried back as much as possible. Fish rescues would be conducted and the fish transferred to Lake Ralphine (at Howarth Park), but anadromous salmonids would not be affected.

The Spring Creek diversion is a small diversion facility that reduces peak flows into Spring Lake. Desiltation is required behind the control structure of the diversion. Generally about 200 cubic yards, but as much as 500 cubic yards of material consisting mostly of gravel and sand, may be removed. This maintenance would occur approximately once every 5 to 10 years.

Small-scale (radius of 50 feet) silt, debris and vegetation removal would be performed as part of the structure maintenance work on the outfall of Brush Creek every 3 to 5 years along with regular mowing. Although sediment removal has not been needed in the past, it may be necessary in the future. Piner Reservoir has not been excavated in recent years, but sediment removal is likely to be needed in the future. Piner and Brush Creek reservoirs have small capacities, so sediment removal activities would take place later in the summer when the water has naturally evaporated. Paulin Creek would be maintained approximately every 15 years.

4.4.1.4 Sediment Maintenance and Channel Debris Clearing Practices

Sediment removal would be conducted with excavators with extended arms, and in some areas, with bulldozers and front-end loaders as well. Excavating equipment with a reach appropriate for the channel being cleared would be used. The equipment would be driven along the access road, and sediment removal would be done perpendicular to the channel length. Bulldozers would be used in high width/depth ratio channels where excavators cannot reach the channel bottom from the service road. A bulldozer would stockpile sediment to a closer area and then stockpiles would be removed with an excavator.

Sediment removal would be performed in the summer when the stream may be dry. However, if water were still flowing in the channel, streamflow would be diverted around the project. Alternatively, for small projects, barriers would be constructed upstream and downstream as necessary. The barrier would slow the flow of water, which would allow suspended sediment to settle out where it can then be removed.

In dry channels, a front-end loader, bulldozer, or excavator would be used in the channel bottom. A loader or excavator can load a dump truck in the channel bottom. The heavy equipment would be driven along the channel bottom after being driven in on an existing ramp, a temporary access ramp, or over shallow sides. Sediment and debris would be placed directly into dump trucks or semi-trucks on the channel bottom.

Before implementation of sediment removal activities, the sites scheduled for sediment removal would be evaluated by SCWA staff biologists to make any needed recommendations for protecting aquatic and riparian species and habitat. If the potential for salmonid species to occur in the area during the project is identified, sediment removal operations would be modified to include a fish rescue by staff biologists. Fish rescue activities have not been needed in the past because of the poor-quality habitat that exists in the channels that typically accumulate sediment.

Grade-control structures and fish ladders under SCWA's jurisdiction would be inspected annually, and cleared of debris, as necessary, to protect the structures. Hand labor or heavy equipment (i.e., excavator or backhoe) would be used to clear debris from structures.

Large debris would be removed from constructed flood control channels, flood control reservoirs, and to a very limited extent in natural waterways associated with emergency sediment maintenance and bank stabilization activities. It would be removed on an as-needed basis, as determined through the cooperative efforts of SCWA operations and maintenance personnel and fisheries biologists. Large woody debris would be allowed to remain in flood control channels if it does not threaten bank stability or the flow capacity of structures such as bridges and culverts. Large woody debris or other structures providing fish habitat would only be removed if the debris were causing a significant erosion problem or flow blockage. Large anchored jacks that have come loose from their original placements and are found in the Russian River channel would also be removed on an as-needed basis.

Before large woody debris would be removed, it would be evaluated by SCWA staff. If it is determined to be stable (i.e., not likely to be dislodged, washed downstream, and threaten the integrity of a structure), it would be left in place. For example, a piece of large woody debris was left in place on Brush Creek recently because it was downstream of the Highway 12 bridge and was not in a position to float downstream and cause a debris jam at any bridges. Loose pieces of large woody debris may be anchored in place if found in an area where they are not likely to pose a threat. If large woody debris appears in a constructed channel in downtown Santa Rosa, particularly if it is 20 feet or longer, it is likely to become lodged at a bridge and create a blockage. Large woody debris presenting this kind of threat to infrastructure would be removed. If large woody debris is determined to pose a hazard, it would be removed in consultation with CDFG and NOAA Fisheries. Large woody debris would be removed with a winch from the top of the bank, cut up with chain saws, and transported away. Brush would be chipped and put on landscaped areas.

4.4.2 VEGETATION MAINTENANCE

Vegetation maintenance on streambanks and within channels would be conducted by SCWA to maintain bed and bank stability on Dry Creek and the Russian River, and to maintain flood capacity for the natural waterways and constructed flood control channels. To meet the objectives of channel stability and flood control while protecting aquatic and riparian habitat, SCWA has refined its procedures for vegetation maintenance on constructed flood control channels and natural waterways (Tables 3-12 and 3-14). These practices, which differ significantly between the natural waterways and constructed flood control channels, are described below. SCWA has hydraulic maintenance easements that are permissive and allow SCWA to access various natural creeks to remove debris or vegetation to restore hydraulic capacity and to protect property. SCWA's proposed vegetation maintenance activities are described in more detail below.

Channel maintenance activities in the Russian River and Dry Creek performed under USACE obligation include both vegetation and sediment maintenance. These activities are discussed separately.

4.4.2.1 Vegetation Management in Constructed Flood Control Channels

SCWA maintains approximately 150 miles of constructed flood control channels (Table 3-12). Many of these channels were designed to provide 100-year-flood capacity. The original design capacity assumed that streambanks would be predominantly grass, with little or no tree growth, and the streambed would be maintained clear of vegetation and sediment.

Channel Capacity Assessment and Adaptive Management

A hydraulic assessment of selected Zone 1A constructed flood control channels was performed in 2000 to identify flood capacity under various vegetation management scenarios (Table 3-13) (ENTRIX, Inc. 2002a). The hydraulic assessment showed that for many of the channels, moderately dense shrubby vegetative growth with young developing willows (approximately 5 years old) on portions the streambank, and tule growth on the streambed, would cause impairment of hydraulic capacity, so that the 100-year flood might not be contained. To maintain original-design-flood capacity in these channels, it would be necessary for SCWA to keep vegetation from growing into a dense brushy stage. Should the amount of vegetation in these channels be greater than that described above, these channels would likely not be able to accommodate the flows necessary to prevent floods.

Additionally, SCWA is currently reviewing a preliminary hydrology study conducted by USACE (2002a). That study determined that 100-year-storm flows in the Santa Rosa Creek watershed are of a greater magnitude than had been historically calculated and used for the design of flood control channels.

SCWA is currently reviewing the recent USACE (2002a) draft hydrologic engineering report to determine the extent to which peak flood flows in the Santa Rosa Creek drainage exceed flood peaks used as the basis for the original design of the flood control channels. SCWA will also be performing additional hydraulic modeling to assess the capacity of its flood control channels.

If USACE analysis is verified, SCWA will evaluate various flood-control options to address the higher peak flows. Zone 1A flood control channels and flood detention basins will be assessed to see if they provide 100-year-flood protection. Revised channel maintenance practices, in combination with new or redesigned flood control facilities, may be necessary. The specific mix of options available to achieve flood protection would be evaluated based on a more detailed understanding of peak-flood magnitudes associated with each of the sub-basins contributing to the Santa Rosa Creek watershed, and the engineering feasibility of various design options. From the hydrologic and hydraulic modeling results, a range of opportunities will be investigated to determine whether there are feasible methods for reducing flood peaks in order to contain the 100-year flow.

The results of these technical studies will be used to form the basis of an adaptive management approach. The effects of vegetation management protocols on flood capacity would be monitored and evaluated to determine whether modifications to the protocols are appropriate. If a channel exhibits less capacity than modeled, additional measures would be implemented to improve capacity. If a channel exhibits greater flood capacity, the management protocols would be modified to allow more vegetative growth if needed to support habitat value of the channel.

Where feasible methods to reduce flood peaks are identified and developed, and adequate channel capacity can be maintained, SCWA would allow more mature or more dense vegetation to grow in the constructed flood control channels than is currently proposed.

Site-specific areas would be evaluated for ways to increase channel capacity while reducing effects to, or increasing habitat value for, salmonids. One option would be to lower one of the two service roads along a channel so that it becomes part of the high-flow channel, thereby increasing the cross-sectional area. A service road that is at the top of a levee or bank can be lowered by excavating a portion of the top of the bank, thereby increasing channel capacity. This action would be feasible only in channels that have a sufficiently wide right-of-way between the existing service road and the bordering fence-line to provide enough room for a stable bank after excavation and lowering of the service road. Lowering the service road would be considered only in areas that currently require frequent maintenance or where design-flood capacity is currently insufficient. The locations where the service road could be lowered and where this would be desirable to improve flood capacity would be identified and evaluated for potential modification. Increasing channel capacity in this manner could enable the creek to be managed with more mature riparian vegetation and a more natural geomorphic and ecological form.

In areas where it would be feasible, some of the bar features within the channel would be retained. This would occur while still maintaining adequate channel capacity, and where improved passage to upstream rearing or spawning habitat would be beneficial. Enough instream vegetation and/or sediment would be removed to maintain channel capacity, but some of the root structure would be left in place to stabilize the bars in the low-flow channel and maintain deeper water depth for fish passage.

Channel Maintenance Zones

To maintain constructed flood control channels, SCWA has apportioned the maintenance activities into five “zones”: top-of-bank, upper channel bank, middle channel bank, lower channel bank, and the channel bottom. Maintenance activities in top-of-bank and upper channel are consistent among all constructed flood control channels. Maintenance activities in the lower three zones (upper, middle, and lower channel bank) would vary depending on channel capacity and flood risk.

<u>Top-of-Bank</u>

The top-of-bank zone maintenance includes:

- landscape maintenance
- fence/gate maintenance
- V-ditch and drop inlet maintenance
- service road maintenance

The access roads for the constructed flood control channels would be kept clear of vegetation with the use of aquatic contact herbicides (which are effective only at the time of application [i.e., early spring]) and mowing. The portion of the channel between the access roadways and the fence lines that border the channels would be mowed twice annually for fire control purposes and structure integrity. In areas that do not contain access roads, an area of width 1.5 times the average height of the fuel source would be mowed adjacent to the fence lines. Mowing in this area would avoid native trees.

<u>Upper, Middle, and Lower Banks</u>

The upper and middle channel bank zones typically consist of the upper two-thirds of the channel bank (which is generally everything above 5 feet higher than the channel bed). The lower channel bank zone comprises the area in the lower third of the channel bank (typically lower than approximately 5 feet above the channel bed), including the toe of the channel.

Vegetation Maintenance Levels

The level of vegetation maintenance applied would depend on the hydraulic capacity required in the channel. One of three vegetation management practices would be applied, maintenance of the original design capacity, intermediate vegetation maintenance, or mature riparian vegetation maintenance.

Original Design Capacity Maintenance

In site-specific areas where the hydraulic assessment (ENTRIX, Inc. 2002a) indicates that simulated flows are near or just over-bank, vegetation would be maintained at the original-design-capacity scenario. SCWA would keep vegetation from growing into a dense brushy state. Vegetation maintenance practices may include limiting vegetation on streambanks to predominantly grass with little or no woody stem growth; maintaining the channel bottom clear of vegetation; and frequent maintenance.

Intermediate Vegetation Maintenance

In some channels, vegetation may be allowed to grow while still maintaining sufficient hydraulic capacity. These are generally channels that have required maintenance every 5 years or more. The following maintenance practices would apply.

Thinning of under-brush and debris removal would take place in the upper and middle zone. Existing mature trees, which are predominantly within the upper third of the bank or at the top-of-bank, would not be removed unless dead, diseased, or downed, and presenting a hazard to adjacent or downstream properties. The lower limbs of existing trees would be periodically thinned and removed to keep them above the floodway elevation (i.e., above top-of-bank).

Channel maintenance practices in the lower channel zone would consist of the removal of understory vegetation. Understory vegetation removal (e.g., blackberries) would be accomplished by hand-clearing and spraying of aquatic herbicides. Small, mechanized equipment may be used to transport the cut vegetation to the top-of-bank so that it may be efficiently removed from the channel. Removal of plants will be selective, based on the species present, with an emphasis on protecting native riparian species wherever possible. Native trees (typically willows) that are growing along the lower one-third of the bank, including the toe of the bank where it intersects the channel bed, would be allowed to colonize as young trees. These trees will provide shade and cover along the wetted channel bottom during the low-flow summer season. However, these young trees must be regularly maintained so that they do not cause significant impairment of flood capacity and do not provide an opportunity to catch woody debris during high-flow events. Therefore, the following guidelines will be used to maintain the young trees along the lower third of the bank:

- Certain species of willows (or other native riparian vegetation types such as cottonwoods and alders) would be allowed to grow to no more than one-half the total design depth of the channel.

  For example, a channel with a design depth of 20 feet may have willows that grow to a height of approximately 10 feet. Young trees that exceed one-half the depth of the channel would be cut and stump-treated with approved herbicides. Where possible, existing trees of 4 inches in diameter or larger may be retained in trade for removing smaller trees in the immediate area. Where hydraulic capacity would not be impaired, the growth of colonies of mature trees would be encouraged, spaced intermittently in the channel, or for shading adjacent to pools.

- All limbs growing out from the main trunk will be pruned as the trees grow so that the lowest limbs are at least 5 feet above the ground elevation.
- Any trees with more than one developing trunk will be pruned to a single main trunk. Because arroyo willows take a shrubby form, this particular species will be completely removed from the channel whenever they are identified. However, if other trees are not there, some willows may be left.
- Initial spacing between colonizing trees will be approximately 15 feet. If tree canopies begin to fill-out so that they are overlapping or touching, then the spacing between trees will be increased by thinning.

Mature Riparian Vegetation Maintenance

In some channels, complete canopy cover could be achieved by allowing the development of mature, single-trunk trees with most of the canopy above the floodway elevation. Native trees would be maintained (i.e., thinning or pruning) or planted. Vegetation at the channel toe and in the lower third of the bank would be maintained parallel with the flow and spaced 15 to 25 feet, depending on the species. Lower limbs would be pruned to maintain channel capacity. To achieve a mature canopy cover, adequate flood capacity must exist in the channel both during the period when young trees are growing within the floodway and at later mature stages when these trees have canopies that rise above the floodway elevation.

Mature trees and plantings would increase the riparian habitat value of the channel over original design capacity (baseline conditions) or intermediate vegetation maintenance. An example is the riparian corridor that has developed along a restored section of Brush Creek (Section 4.5.2.12). On this creek, trees were planted in a fairly straight line parallel to the stream, providing riparian vegetation while minimizing reduction of hydraulic capacity.

Channel Bottom

The channel bottom of constructed flood control channels would be cleared of vegetation through the use of spray aquatic contact herbicides and hand clearing. Future selected vegetation clearing from the channel banks may be necessary to allow access to the channel bottoms for silt removal operations. Small, mechanized equipment may be used to transport the cut vegetation to the top-of-bank so that it may be efficiently removed from the channel.

Level of Vegetation Management in Constructed Flood Controls

Table 4-6 lists the flood control channels and an estimate of the level of maintenance that would be performed (see Figure 3-5 and -6). This table shows that portions of some channels with potential salmonid habitat would require original-design-capacity maintenance practices, including Paulin, Piner, Santa Rosa, Brush, Crane, Laguna de Santa Rosa, Rinconada, and Todd creeks. Additional channels that require this level of maintenance may act as a migration corridor only. An adaptive management approach (described in Section 4.4.2.1) would be implemented to assess which channels may in the future have maintenance protocols that allow more vegetation to grow.

For bridges and culverts that do not have the capacity to pass the 100-year discharge under the intermediate maintenance, it would be necessary to implement original design

Table 4-6 Levels of Vegetation Maintenance Work in Flood Control Channels[1]

Creek	Summer Flow[2]	Species Known to Occur[3]	Potential to Support Spawning/Rearing Habitat
Streams that Require Original Design Maintenance Scenario			
Migration, Rearing, and Spawning			
Paulin	Yes	St	Yes
Piner			Yes
Santa Rosa	Yes	Co, St, Ch	Yes
Migration and Rearing			
Brush		St	Yes
Crane			Yes
Laguna de Santa Rosa	Yes	St	Yes
Rinconada	Yes		Yes
Todd		St	Yes
Migration Only[4]			
Austin[5]		St	Yes
Coleman			
Colgan			
Copeland			
Cotati			
Ducker			
Five			
Forestview			
Hinebaugh		Ch	
Kawana			
Lornadel			
Roseland			
Gossage / Washoe			
Wilfred	Yes		
Windsor	Yes		
Streams that Require Intermediate Vegetation Maintenance			
Migration, Rearing, and Spawning			
Oakmont	Yes		Yes

Table 4-6 Levels of Vegetation Maintenance Work in Flood Control Channels[1] (Continued)

Creek	Summer Flow[2]	Species Known to Occur[3]	Potential to Support Spawning/Rearing Habitat
Streams that Require Intermediate Vegetation Maintenance (Continued)			
Migration Only[4]			
College			
Faught			
Hunter Lane Channel		St, Ch	Yes
Indian			
Peterson			
Russell			
Spivok			
Starr			
Steele			
Wendel			
Windsor tributaries			
Streams with Mature Riparian Vegetation Management			
Sierra Park			
Spring			
Wikiup			

[1]Source: SCWA (Paul Valente and Bob Oller, Maintenance Division).

[2]Summer base flow that is not supported by relatively recent urban runoff. Portions of these channels dry up in summer, but other portions retain base flow.

[3]Where rearing activity occurs, species are listed if known. Salmonids may use other channels currently or in the future. Co = coho salmon; St = steelhead

[4]Migration corridor assumed to be a function of all flood control channels.

[5]Austin Creek in Rincon Valley, not in West Sonoma County.

capacity vegetation maintenance practices near the bridge structures. These may include removing all vegetation except grasses within approximately a distance equal to the channel top-width both upstream and downstream from the bridge.

Since vegetation removal practices were modified in the last few years, significant tree growth has occurred on several engineered channels such as Brush, Santa Rosa, Copeland, and Hinebaugh creeks. This vegetation may need to be thinned, pruned, or removed.

SCWA also has vegetation maintenance responsibilities on a section of Santa Rosa Creek for the Prince Memorial Greenway restoration project and for a restoration project on the lower reaches of Brush Creek. In general, these responsibilities include maintaining vegetation that has been planted along the streambanks for each of these projects (on Brush Creek vegetation is not cut on the lower one-third of the streambank), so that there is no loss of the riparian canopy. SCWA is responsible for channel maintenance of these restored flood control channels and will implement the least intrusive maintenance protocol that provides flood protection.

4.4.2.2 Vegetation Management Practices in Natural Channels

For the natural channels (other than the Russian River and 15 channel improvement sites along Dry Creek) where vegetation removal may occur, SCWA does not have routine or regularly implemented maintenance obligations. Maintenance on natural waterways (Table 3-14) would consist of clearing vegetation from the bottom of natural waterways to restore hydraulic capacity. Hand labor is the typical clearing method. Heavy equipment would only be used to lift out or clear debris jams not accessible to hand crews.

One of SCWA's riparian enhancement project goals is to create a shade canopy over the stream channel, which reduces plant growth on the channel bottom, and in turn helps maintain hydraulic capacity. In accordance with this goal, native trees growing along streambanks have been allowed to establish. Some vegetation understory along the channel banks and in the main channel that could substantially reduce hydraulic capacity would be removed by mowing (upper third) or hand clearing, as needed. This practice would be implemented by SCWA staff, including both operations and maintenance personnel and staff biologists. SCWA staff may occasionally need to use herbicides (approved for aquatic use) and/or hand labor to remove invasive exotic species. Native vegetation would generally not be removed unless it presents a significant flood risk.

SCWA staff have observed, through various maintenance and riparian enhancement projects, the effectiveness of maintaining (thinning or pruning) or planting native trees along the streambank in a fairly straight line parallel to the stream. These trees and plantings have increased the riparian habitat value of the stream. This procedure for riparian enhancement plantings would continue to be implemented as part of SCWA's fisheries and riparian restoration projects in the Russian River watershed.

Vegetation control along the levee access roads of the Mirabel/Wohler diversion facilities would be done as needed using hand removal or an herbicide approved for aquatic use. Blackberries that grow in channels connecting the diversion at the Russian River with the infiltration ponds would be removed by hand once a year. Mowing on levee roads generally would occur in late spring each year.

4.4.3 BANK STABILIZATION IN THE RUSSIAN RIVER AND DRY CREEK

SCWA and MCRRFCD were designated as the local agencies responsible for channel maintenance below Warm Springs Dam and Coyote Valley Dam, in Sonoma and Mendocino counties, respectively. SCWA's and MCRRFCD's bank stabilization activities on the Russian River and its tributaries would be limited to maintenance of past channel improvement projects. Several projects were implemented by USACE on the Russian River from RM 98 near Calpella to approximately RM 40 in Healdsburg. In addition to maintaining channel improvements installed for Coyote Valley Dam, SCWA and MCRRFCD would continue to inspect channel improvement sites that were constructed between 1956 and 1963.

MCRRFCD conducts channel maintenance in Mendocino County. MCRRFCD was the lead agency on two non-project levees under Public Law 84-99, located in Hopland on

Fetzer Vineyard properties and at the Calpella County Water District. USACE conducted annual inspections of these levees and, along with the landowner, was responsible for the repair of the levees. The Fetzer Vineyard and Capella County Water District sites are now out of the active USACE program.

Maintenance activities would be proposed by USACE, SCWA and MCRRFCD, and a letter submitted to NOAA Fisheries annually for review and response. Projects would be designed in consultation with NMFS and CDFG, and would conform to authorized take limits set in the Incidental Take Statement issued by NOAA Fisheries.

Dry Creek

Channel maintenance activities on Dry Creek are limited to maintaining USACE channel improvements at 15 locations that were installed to prevent bank erosion following construction of Warm Springs Dam. These improvements are identified in the USACE operation and maintenance manual prepared in July 1991 (USACE 1991). Under the proposed project, SCWA would continue to maintain these 15 channel improvement sites. Maintenance work associated with these sites can involve incidental sediment removal, vegetation removal, removal of debris, and bank stabilization. Vegetation removal would only occur to improve bank stability if trees are leaning or otherwise directing high flows against the bank, causing erosion, and to visually inspect a bank stabilization structure. Bank stabilization work typically would involve replacing lost riprap and, if necessary, regrading the bank slope to its previous contours in order to provide a stable base for the riprap. Riparian vegetation on the channel banks and bars would be left in place, if not threatening bank stability, to maintain shade for aquatic habitat.

Outside of the work done on the 15 grade and bank erosion control structures, additional vegetation removal for flood control or bank erosion is not a USACE obligation and would not be performed in Dry Creek. However, limited work may be performed in Dry Creek, specifically at landowner request in response to extreme flood flows that result in bank erosion that threatens property or structures. This type of work would occur infrequently.

SCWA would continue to inspect the one nonfederal levee (Public Law 84-99) on Dry Creek. The property owner is responsible for needed repairs.

Russian River

Under the proposed project, SCWA and MCRRFCD channel maintenance activities would be conducted in the Russian River. USACE and SCWA would periodically inspect the channel improvement sites and levees. USACE would then recommend maintenance work that may be needed. In general, SCWA and MCRRFCD would be required to keep the project levees free from vegetation, remove instream gravel bars that may be impeding flow, and inspect and maintain the channel improvement sites. Typical maintenance activities for channel improvement sites in the Russian River are similar to those on Dry Creek, and include removing loose anchor jacks from the river, repairing and replacing loose grout or riprap, adding bank erosion protection at sites found to be eroding, and managing vegetation and removing flood debris to reduce blockage of the river channel that is causing bank erosion or preventing inspection of channel improvement sites.

Repairs to bank stabilization structures in Dry Creek and the Russian River would be as needed when identified during USACE inspections, and would employ BMPs to minimize disturbance to listed species during construction activities. Large anchored jacks that have come loose from their original placements and found in the river channel would be removed. Vegetation removal at bank stabilization structures would only occur if vegetation threatens the integrity or function of a structure. Sediment removal would be conducted to prevent flows from being directed toward a bank that is eroding.

SCWA would conduct inspections of nonfederal levees, but if major repairs were needed, the property owner and USACE would be notified.

4.4.3.1 Gravel Bar and Overflow Channel Maintenance in the Mainstem Russian River

Under the proposed project, MCRRFCD would perform streambank maintenance consisting of obstacle removal, streambank repair, and preventive maintenance over a 36-mile reach of the Russian River in Mendocino County. SCWA would perform streambank maintenance in the mainstem Russian River in Sonoma County. However, gravel bar grading activities under the proposed project would be more limited than under baseline conditions, and protocols would be implemented to reduce the potential for negative effects on salmonid habitat.

Conservation measures provided in the terms and conditions of BOs issued by NOAA Fisheries to Syar Industries and Shamrock Materials, Inc. for instream gravel mining operations, as well as measures in the ARM Plan, may be useful to implement in the proposed project for bank stabilization work in the Russian River. However, streambank stabilization is very different from gravel extraction, and, therefore, conservation measures will differ as well.

Bank erosion occurs when flow is directed into the riverbank by large gravel bars that are often well vegetated. To reduce bank erosion in the mainstem Russian River, instream gravel bars that contribute to bank erosion would be regraded, and overflow channels would be created to direct the river channel away from susceptible banks. Maintenance work would be directed toward reshaping and removing a portion of these bars. This action specifically addresses sites where the formation or growth of gravel bars is likely to cause severe bank erosion.

MCRRFCD has identified approximately 23 sites along the river in Mendocino County that have required maintenance work in the past (B. Spazek, pers. comm. 2003). Areas identified as problem areas are usually located at curves in the river. Three to four sites have been worked on annually. The selected sites ranged in size from very small areas to reaches up to 100 yards long. Under the proposed project, MCRRFCD would continue to assess approximately 12 miles of river each year and would limit the site size to between

10 feet and 300 feet in length. Up to three or four sites would continue to be selected on the basis of need for streambank erosion control. CDFG staff would continue to participate in site visits and evaluate site selection.

SCWA would also limit this maintenance work in the river in Sonoma County to no more than three to four sites per year.

Protocols would be implemented to reduce effects to salmonid habitat. The gravel bar grading protocols are listed in the following section.

USACE would, in cooperation with NOAA Fisheries and CDFG, review the sediment and vegetation control obligations contained in the USACE O&M manuals and modify them to minimize the effects of channel maintenance activities on listed fish species. These modifications would be identified in the Section 404 permits required for the channel maintenance activities.

MCRRFCD would continue to assist property owners with bank stabilization on the Upper Russian River in Mendocino County by being the lead agency, when necessary, for obtaining public law funding when major bank failures have occurred. MCRRFCD would also encourage property owners to stabilize their banks by planting native vegetation along the banks to reduce erosion.

Gravel Bar Grading Protocols in the Russian River

Certain conditions may warrant some degree of channel maintenance. Channel maintenance activities may be conducted if one or more of these conditions exist:

- Occurrence of severe bank erosion.
- Recent substantial changes in channel morphology that are likely to lead to severe bank erosion.
- Evidence of weakened levees.
- Threats of flooding to infrastructure or private property.

Bank erosion is a natural process, where a dynamic balance between the dominant discharge and the sediment load determines the sinuosity and slope of the river channel. In equilibrium, a meandering channel develops, where bank retreat opposite the bars is, on average, balanced by deposition at the inside of bends. Gravel bar grading may be implemented if there is evidence of severe bank erosion, or recent substantial changes in channel morphology suggest that severe bank erosion is likely during the next rainy season. As a general guideline for this BA, "severe bank erosion" is characterized as a substantial loss of streambank material. Although the characterization of severe erosion is likely to be site-specific, an example of how severe bank erosion may be defined is the loss of streambank material that, measured in the vertical, is approximately equivalent to three-quarters of the total bank height and continuously extends for at least 200 linear feet (lf) along the channel.

Gravel bar grading would be conducted in a manner that provides increased protection for the low-flow channel and native vegetation, and reduces the need for channel bar grading. A qualified fish biologist would evaluate the habitat and biological features of each proposed site prior to implementation of grading. Project planning would be coordinated with NOAA Fisheries and CDFG.

The maintenance work would consist of grading bars in the channel during the dry summer season during low-flow periods and creating an overflow channel if needed. Maintenance work would occur between July 1 and October 1 to avoid spawning and incubation periods.

No grading would be conducted in the low-flow channel. Buffers (i.e., areas of undisturbed habitat) would be maintained along the edge of the low-flow channel to help maintain bar form, prevent deposition of material into the river, and to keep heavy equipment out of the wetted channel. A buffer width of at least 25 feet or 10 percent of the maximum bar width, whichever is less, would be maintained along the edge of the low-flow channel, whether vegetation is present or not. A buffer of 25 feet or 10 percent of the maximum bar width, whichever is less, would be maintained along the bank/levee side of the bar to reduce erosion along the bank.

If a channel bar is graded, the elevation of the post-graded bar would be at least 1.5 feet higher than the elevation of the edge of the low-flow channel to maintain the thalweg of the channel. Sediment would be contoured to create a slope that runs up and away from the centerline of the main low-flow channel that is at least a 2 percent grade from the water surface elevation at low flow, or baseline elevation at the water surface, whichever is higher. The slope parallel to the flow of the river would be consistent with the adjacent stream grade.

Openings would be provided on the upstream and downstream ends of the bar on the buffer zone to provide even drainage and to decrease the risk of juvenile salmonid stranding when high flows recede.

Any large woody debris that is moved or extracted would be deposited either on the upstream buffer area or along the low-flow channel buffer where it can be redistributed in the high flows of the next rainy season. If it poses a risk to property, it may be anchored or placed elsewhere in the river.

This work would be primarily performed using heavy equipment, such as front-end loaders, an excavator with an extended arm and thumb as well as an appropriately sized bulldozer. Equipment fueling and maintenance would be conducted outside of and away from the river channel. Because gravel bars do not always form in the same river sections over the years, new access roads may be required. Where possible, existing access roads would be used, and construction of new access roads would be limited to the fullest extent possible. Road widths would be limited to a width that allows one vehicle to pass. If needed, up-slope sediment control measures such as silt fences would be installed to reduce sediment input to the stream channel.

Gravel bar grading would be limited to that material necessary to reduce the risk of bank erosion. If necessary, gravel would be removed from the channel. Gravel removed from the lower Russian River may be relocated to Dry Creek (on USACE property at the head of the creek) as part of restoration activities, after written notification of and approval by NOAA Fisheries. An assessment would be made of how much gravel could be placed in Dry Creek without altering channel morphology. If future restoration actions in the East Fork or the mainstem upstream of the Forks require gravel supplementation, gravel could also be made available for those projects as well.

It should be acknowledged that natural riverine processes may tend to redeposit gravel and other sediments in areas that have been graded, and that ongoing maintenance may be needed. However, the goal of this action is not to stop re-formation of gravel bars, but to manage them in such a way to reduce the risk of extensive bank erosion that accompanies bar development. Section 4.4.3.3 describes a monitoring program that will identify areas subject to frequent or extensive maintenance and outlines potential alternatives to address bank erosion at those sites.

4.4.3.2 Vegetation Maintenance in the Mainstem Russian River

Under the proposed project, MCRRFCD would continue to perform vegetation maintenance to control bank erosion. Vegetation would be removed from gravel bars that contribute to bank erosion, implementing the following protocols that limit the potential for negative effects on salmonid habitat.

Vegetation Maintenance Protocols in the Russian River

Vegetation maintenance work may be conducted if one or more of these conditions exist:

- Encroachment by *Arundo donax (Giant Reed)* or other exotic pest plant species.
- Occurrence of severe bank erosion.
- Recent substantial changes in channel morphology that are likely to lead to severe bank erosion.
- Evidence of weakened levees.
- Threats of flooding to infrastructure or private property.

Invasive plant species like *Arundo donax* may be burned in place or uprooted and destroyed outside of the river channel. *Arundo donax* may be mulched using equipment appropriate for this species. In areas where infestations are extensive, heavy equipment such as backhoes, front-end loaders, and bulldozers may be used. Alternatively, *Arundo* may be cut off near ground level and the stump treated with an appropriate, approved herbicide. If effective new treatments are developed in the future for *Arundo* control, they may be implemented. The objective of these treatments is to kill all *Arundo donax* to prevent recolonization by plant tissue.

Vegetation maintenance may be conducted in conjunction with gravel bar grading activities related to streambank erosion control. Vegetation maintenance activities would be conducted in a manner that provides increased protection for the low-flow channel and native vegetation, and reduces the need for channel bar grading. A qualified fish biologist would evaluate the habitat and biological features at each site before implementation of vegetation removal. Project planning would continue to be coordinated with CDFG.

The vegetation maintenance work would be implemented during summer season low-flow periods between July 1 and October 1 to avoid salmonid spawning and incubation periods.

Vegetation removal would occur in a managed zone consisting of an area outside of the low-flow channel and outside a 25-foot vegetation buffer zone next to the low-flow channel. In channels that are wider than 200 feet, a vegetation buffer zone of at least 50-feet-wide would be maintained.

Vegetation in the buffer zone along the low-flow channel may be cropped. Vegetation that is too large to mow would generally be removed by hand. However, if removal of willows and other vegetation in the managed zone cannot be feasibly accomplished through mowing or hand removal, other heavy equipment such as bulldozers may be used. To the extent possible, mechanical methods that leave roots of native species intact would be selected to minimize sediment re-suspension and changes to gravel bar morphology during high flows. In some cases, more aggressive practices may be required to reduce the frequency of vegetation maintenance. In these cases, stumps of larger trees may be treated with contact herbicides, or willow roots may be removed.

Native vegetation that is removed in the management zone would be relocated to the extent possible. The removal of vegetation would include the subsurface material including the root structure. Any vegetation removal that requires gravel bar grading would implement gravel bar grading protocols outlined in the preceding section.

Vegetation removal would be scheduled so that gravel bars are worked on in rotation over a course of 3 to 5 years. Gravel bars would be assessed to identify those that require work. These gravel bars would then be scheduled for work during different years. Once a gravel bar has been worked on, it would be left alone for 3 to 5 years before it is worked on again. In this way, some bars would always have willows that provide high-flow velocity refuge areas for salmonids.

4.4.3.3 Site-Specific Bank Stabilization in the Russian River

Areas along the mainstem Russian River where frequent and/or extensive channel maintenance actions are required to prevent bank erosion would be identified. This information could then be used to assess whether these sites may be candidates for bank stabilization projects.

The location, frequency, and extent of channel maintenance work would be recorded as work is conducted. If specific areas require maintenance work involving gravel bar grading and construction of an overflow channel on a frequent basis (e.g., 3 out of 5 years), the potential to use other bank stabilization methods would be evaluated. SCWA or MCRRFCD would not be required to install bank stabilization projects other than bank revegetation. Where appropriate, revegetation plans to enhance the riparian habitat and bank protection would be limited to planting of native riparian species.

SCWA or MCRRFCD may coordinate potential bioengineered or engineered bank stabilization projects with local landowners or with the USACE, if persistent and severe bank erosion is identified in areas that threaten the integrity of structures and property. SCWA or MCRRFCD may be the lead agency on public-law funding when major bank failures occur. NOAA Fisheries would be notified of proposed bank stabilization structures and a request for approval would be made. If more than 1,000 feet of channel are to be affected by any single project or if the project is within 1,000 feet of a previously armored site, a separate ESA Section 7 consultation would be initiated for that action associated with the respective USACE 404 permit. The intent is to avoid large segments of continuous hard-armoring within the mainstem from cumulatively developing. If bank stabilization activities are implemented, bioengineered structures would be used whenever possible. Where bioengineered bank stabilization methods are not deemed to be practical, then priority would be given to incorporating vegetative plantings into the hard-armoring techniques that are implemented. Fish habitat restoration elements (such as native material revetments) would be incorporated into bank stabilization practices when feasible, with the intent of replacing lost habitat.

Installation of engineered, hard-armor bank stabilization structures may increase the risk that future streambank erosion problems may appear upstream or downstream of the bank stabilization site. Therefore, it may be preferable to implement gravel bar grading and overflow channels on a regular basis at some sites, rather than to implement hard-armoring bank stabilization projects.

4.4.4 Bank Stabilization in Natural Waterways

Through the FEP, SCWA has worked with local landowners to implement bioengineering projects to assist with bank erosion problems. This change in bank stabilization procedures has assisted landowners in protecting the streambank and has improved riparian and fisheries habitat along the Russian River and its tributaries. Examples of SCWA projects are provided in Section 4.5.

Occasionally, bank stabilization and sediment removal would be performed on natural waterways, including the Russian River, in response to bank erosion after unusually large storm events at the request of the landowner. In recent years, this type of work was performed on Austin Creek and Big Sulphur Creek.

The Big Sulphur Creek work serves as an example. In September 1995, SCWA was the local sponsor for a project to remove sediment from the channel, which had aggraded approximately 8 to 10 feet due to landslides the previous winter. In October 1997, another sediment removal project was necessary following the large storm events in January 1997. In both cases, the channel aggradation posed a significant flood risk to the surrounding area; thus, the activity was treated as an emergency repair action.

Potential activities would include bank stabilization, levee repair, vegetation or sediment removal, or channel realignment. These activities would be initiated only by a request from a private landowner after a washout threatens property or structures. Based on past history, such activities occur approximately once every 5 to 10 years. Typical project lengths under these circumstances are approximately 500 feet, but could be up to 1,000 feet. SCWA would not implement bank stabilization or sediment removal activities in natural channels if more than 1,000 feet of channel would be affected by any single project. As described earlier, a separate ESA Section 7 Consultation would be initiated for actions that affect more than 1,000 feet of channel or would be within 1,000 feet of a previously armored site.

Potential direct and indirect effects of a project to salmonid habitat would be considered during project planning and efforts made to reduce adverse effects to listed species. Construction would occur during the summer to avoid spawning and egg incubation periods. Before any activity is implemented, the site would be assessed with a qualified fisheries biologist. Feasible alternatives would be considered, and plans would be developed in consultation with CDFG. The planning phase would include an assessment of habitat and biological resources in the area, and consideration of those factors that may have contributed to the washout or sediment deposition.

Bioengineered bank stabilization methods would be given priority on smaller channels (less than 50 feet wide), when they are deemed to be a feasible and effective treatment. In larger channels were bioengineering techniques would not be feasible or effective, riprap or other hard-armoring measures may be used. Vegetative plantings would be incorporated into these bank stabilization measures as feasible. Fish habitat restoration elements would be incorporated into bank stabilization measures where feasible. Examples of such measures include the use of native material revetments, which combine boulders, logs, and live plant material to armor a streambank (as outlined in Flosi et al. 1998). Revegetation with native plant species would always be implemented in association with bank stabilization measures if site conditions are suitable.

As part of bank stabilization efforts, it is also sometimes necessary to remove deposited sediments or vegetation growing on bars. Preference would always be given to thinning vegetation on gravel bars, which allows gravel to move over time so that it does not have to be excavated with heavy equipment. However, bars would be removed if necessary to prevent erosion that would occur if flows are directed into vulnerable streambanks by the bar deposit. If large woody debris is present in the excavated sediment deposits, it would be removed from the stream only if it threatens to de-stabilize a section of streambank. Otherwise, the large woody debris would be allowed to remain in the channel. On occasion, it is preferable to straighten a short portion of the channel by cutting off a meander instead of excavating the bar sediments if the bank cannot be sufficiently stabilized by other means. If this realignment practice is used, SCWA would consider replacing any lost habitat by incorporating native material revetments as discussed above.

Standard BMPs would be applied to work in natural channels. If possible, sediment excavation and bank stabilization would be performed under low-flow conditions, generally during the summer or fall months. If the channel is not dry, flows would be diverted, typically using earthen cofferdams, pea gravel, or, if necessary, a clean bypass. A fish biologist would inspect the reach where dewatering must occur to allow in-channel work. Fish rescues would be conducted, if necessary. Work would be performed using heavy equipment, which may include backhoes, excavators, and dump trucks, depending on the site configuration and available access. BMPs for operating equipment in or near an active channel would be followed as outlined in Section 4.4.1.4.

4.4.5 Gravel Bar Grading in the Mirabel/Wohler Diversion Area

Gravel bar grading would continue to be conducted in the Russian River near the Mirabel/Wohler diversion areas. The protocols for gravel bar grading operations conducted to increase infiltration capacity may differ from those conducted for channel maintenance. Therefore, these activities are discussed separately.

Infiltration capacity at the Wohler and Mirabel diversion facilities would be augmented by periodically recontouring three gravel bars in the Russian River upstream of the inflatable dam (Wohler, McMurray, and Bridge gravel bars) and excavating one bar (Mirabel Bar) downstream of the inflatable dam near the Mirabel infiltration ponds. Work in other gravel bars may be required in the future if the pattern of gravel bar formation in the river changes so that new bars are formed. These would likely be located between the proposed Caisson 6 and Caisson 3. The McMurray and Mirabel bars are approximately 1,000 feet long and 200 feet wide. The other two gravel bars are approximately 500 feet long and 100 feet wide.

The gravel bars would be graded to lower the level of the streambed so that the area is flooded when the inflatable dam is raised. Gravel bar skimming operations would be performed outside of the active low-flow channel on the Wohler, McMurray, and Bridge gravel bars in the spring of each year (or as needed) when streamflows drop below 800 cfs, and before the dam is inflated. When this work would be performed would vary, depending on the flow in the river and demands on the water system, but would generally occur between March and July.

At the Mirabel Bar, a barrier would be first constructed to prevent water from flowing through the area to control sediment. In addition, sediment fences would be used to prevent the input of sediment into the river. The Mirabel gravel bar would be excavated between July and October, depending on flow conditions.

Gravel at these locations would generally be pushed up on the bank using bulldozers and scrapers; in the future some may be removed and stockpiled outside of the floodplain. The material from the Mirabel gravel bar would be removed and hauled away. The largest of these bars (McMurray Bar) forms approximately 2,000 feet upstream of the Wohler Bridge near the mouth of Porter Creek. At flows above 800 cfs, the McMurray Bar is not accessible. There is a secondary channel between the McMurray Bar and the northern bank. When the water level in this secondary channel drops below approximately 3 feet at the crossing point, equipment would be moved out onto the bar to conduct grading operations.

The Bridge Bar is located on the north (Mirabel side) bank of the river near the Wohler Caissons. A second smaller bar located near SCWA's Mirabel collectors is also skimmed each year. The Wohler gravel bar is located on the eastern shore of the Russian River near Caisson Number 1. Gravel at this bar would either be pushed into piles along the banks, or removed from the bar using scrapers and placed in a stockpile located between Caisson 2 and Wohler Bridge. The Mirabel Bar is located near Caisson 3 on the northern side of the Russian River. Gravel from this bar would be removed, using bulldozers and scrapers, and placed in a stockpile north of infiltration pond number 1, shown in Figure 4-3. Gravel from both the Mirabel and Wohler stockpiles would be removed by gravel contractors.

After gravel bar grading operations on the Mirabel bar are completed, the gravel bar would be contoured to reduce the potential for fish stranding. The elevation of the post-graded bar would be at least 1.5 feet higher than the elevation of the edge of the low-flow channel to maintain the thalweg of the channel. Sediment would be contoured to create a slope that runs up and away from the centerline of the main low-flow channel at a 2 percent grade from the low-flow water surface elevation, or baseline elevation at the water surface, whichever is higher. The slope parallel to the flow of the river would be consistent with the adjacent stream grade. This practice could be implemented on other bars in the future if needed.

The spoils from the gravel bar grading operations would be mounded in the riverbed. If the gravel volume is very large, spoils may have to be relocated or stockpiled outside of the floodplain. The sediment size varies from year to year but generally consists of sands and gravels. The operation would be done during the dry season (e.g., July in 1999), and, if necessary, a cofferdam would be built to keep water out of the work area. The cofferdam would be breached to let water in once the sediment is removed.

The area and volume of sediment removed from the gravel bars would vary from year to year. In summer 1999, approximately 6,500 cubic yards of gravel were removed in the Mirabel area and in 1998, 1,650 cubic yards. In 1999 in the Mirabel area, two D-6 Cats, a motor grader, and a water truck for dust control were used. The equipment entered the bar from the west bank.

The following BMPs for gravel bar grading operations were evaluated by SCWA during a 5-year monitoring study (Chase et al. 2000) and will be implemented as part of the proposed project.

- Biological oversight will be provided by fisheries biologists. SCWA biologists will inspect the gravel bars before beginning gravel skimming work to a) evaluate the need for silt fences, and b) identify environmentally sensitive areas.

- Permanent vegetation on the riverbanks may in some cases be thinned to allow equipment access to the bar, but will not be removed.

- Sediment fences will be employed to prevent the input of sediment into the river.

- Cofferdams will be constructed both upstream and downstream of the work areas, if necessary, to allow access to the work areas.

- Operation of heavy equipment in the active stream channel will be limited to moving equipment to and from the mid-channel gravel bars and breaching cofferdams when needed, and will be very short in duration. All equipment will be removed from the gravel bars at the end of each day.

- No fueling or equipment service will be performed on the gravel bars or within the active floodplain.

- Gravel skimming operations will be limited to material above the waterline.

- After gravel bar grading operations are completed, gravel bars will be contoured to at least a 2 percent grade to reduce the potential for stranding fish.

- Continuously recording turbidity meters will be installed upstream and downstream of gravel bar grading operations.

Breaching of the lower berm for the Mirabel Bar will be conducted late in the evening or early in the morning to reduce visual effects to recreational visitors at Steelhead Beach.

4.4.6 NPDES Permit Activities

Several activities are undertaken by SCWA, the City of Santa Rosa, and the County of Sonoma as co-permittees for a Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer permit. The 5-year permit was renewed by the NCRWQCB on June 26, 2003, and encompasses a larger area than was included under the first permit term. The largest part of the new boundary of permit coverage is approximately coterminous with the SCWA flood control Zone 1 boundary, which defines the Mark West Creek and Laguna de Santa Rosa Watersheds. All creeks within Zone 1A, as listed in Table 4-7, are subject to this NPDES permit. Two areas outside Zone 1A are also included in the permit boundary: the community of Graton and a small unincorporated area outside of the City of Healdsburg. Only two SCWA flood control channels, Norton Slough and portions of Dry Creek from these other areas, are included within the permit boundary.

Table 4-7 SCWA Flood Control Channels within NPDES Boundary (Portions Thereof)

Austin Creek	Hunter Lane Channel	Moorland Creek	Santa Rosa Creek
Brush Creek	Indian Creek	Oakmont Creek	Sierra Park Creek
Coffey Creek	Kawana Springs Creek	Paulin Creek	Spring Creek
Colgan Creek	Lornadell Creek	Piner Creek	Steele Creek
College Creek	Matanzas Creek	Roseland Creek	Todd Creek

SCWA, the City of Santa Rosa, and Sonoma County have undertaken the following actions related to stormwater discharge under the NPDES permit, many of which benefit listed salmonids:

- The County Board of Supervisors' adoption of a Vineyard Erosion and Sediment Control Ordinance (VESCO) that will help protect creeks.
- Collection of composite and grab samples for chemical analysis during storms to evaluate possible trends of specific constituents.
- Enforcement of existing and new development standards to protect creeks and prevent erosion.
- Outreach efforts undertaken to educate the automotive industry, construction industry, landscape industry, carpet cleaners, high schools, colleges, and food service businesses in pollution prevention and BMPs.
- SCWA implementation of an education program for students and teachers about local watershed issues, pollution prevention, and stream protection.
- Presentation of erosion control seminars to local homebuilders.
- Improvement of responses to spills in storm-drain facilities within the NPDES permit boundary.
- Improvement of the City of Santa Rosa storm-drain cleaning system by implementing a dedicated maintenance crew and computerizing the cleaning tracking system.
- Stream cleanup efforts, including removal of shopping carts, trash, tires, car batteries, mattresses, and other large items.
- City of Santa Rosa implementation of an Integrated Pest Management (IPM) Program that includes a reduction in the use of pesticides. Herbicide use has also been reduced through the use of non-chemical vegetation control methods (e.g., weed mowers, hoeing, hand pulling, and mulching).
- Joint SCWA and City of Santa Rosa implementation of a creek stewardship program.

4.5 RESTORATION ACTIONS

SCWA has implemented, and would continue to implement, many actions that are designed to contribute to the restoration of natural resources in the Russian River watershed, particularly resources of benefit to species listed under the ESA. These efforts include support for state and federal recovery plans; watershed management activities; riparian and aquatic habitat protection, restoration, and enhancement; and water conservation and recycling.

SCWA commits substantial funds, staff, and equipment to these restoration projects. SCWA has spent approximately $800,000 per year on its Natural Resources program, approximately 30 to 40 percent on monitoring at the Mirabel and Wohler diversion facilities (which has yielded valuable information about how listed fish species use the watershed), approximately 50 percent on FEP projects, and approximately 10 percent on meetings. Additionally, SCWA commits in-kind contributions of staff and equipment to restoration projects. For example, the in-kind contribution for restoration work on Big Austin Creek was $7,000 and on Copeland Creek was $31,000. SCWA secured an additional $471,000 in grants in 2000, and additional grant money will be pursued in the future.

To maximize the effectiveness of the dollars invested, SCWA develops project priorities on a basin-wide level, in cooperation with CDFG, other agencies, and private interests in the watershed. SCWA would work to implement priorities and recommendations outlined in the CDFG Draft Basin Restoration Plan for the Russian River Basin (CDFG 2002). Partnerships with other stakeholders in the watershed have been instrumental to the success of SCWA restoration projects and programs. SCWA would expand the indirect beneficial effects of restoration projects by using all available opportunities for public education.

Restoration activities would be proposed by USACE and/or SCWA and a letter submitted to NOAA Fisheries for review and response. Projects would be designed in consultation with NMFS and CDFG, and would conform to authorized take limits set in the Incidental Take Statement issued by NOAA Fisheries.

Actions that were implemented prior to the time the MOU was signed (December 31, 1997) are part of the baseline and were outlined in Section 3.7. Actions proposed or implemented since the MOU signing are part of the proposed project and represent an improvement to baseline conditions. Further details on these actions are provided in the sections below.

4.5.1 WATERSHED MANAGEMENT

SCWA would continue to take a proactive role in restoration and enhancement projects, and stewardship of the watershed. Several specific projects related to SCWA's contributions to watershed management efforts in the Russian River basin are described below.

4.5.1.1 Resource Conservation District Assistance

SCWA has contributed funding for Resource Conservation Districts in the Russian River watershed to develop and implement a Watershed Management Plan. This plan is intended to be a voluntary, watershed-based, locally-driven program to assist the agricultural and grazing community in complying with federal and state endangered species and water quality laws, including the protection of threatened fish species and their habitats. The watershed planning efforts will address soil and water conservation, including the improvement of farm irrigation and land drainage, erosion control and flood prevention, and coordination with community watershed groups. The plan will conform with city and county general plans that are applicable to the Russian River watershed area. In addition, the plan will incorporate the watershed planning needs identified by NOAA Fisheries in notices associated with the listing of coho salmon, steelhead, and Chinook salmon. For example, the listing notice for coho salmon stated that NOAA Fisheries will work with federal, state, and local agencies, including the California Association of Resource Conservation Districts, to develop and implement planning efforts, and that both technical and financial assistance will be made available to farmers in high-priority watersheds.

One program that SCWA has assisted Sotoyome Resource Conversation District with implementing is the "Fish Friendly Farming" program. This program is a voluntary, incentive-based certification program to address recovery efforts of the listed fish species. A technical advisory committee that consisted of grape growers, vintners, farming organizations, environmental organizations, and government officials worked together to develop a set of BMPs aimed at restoring and enhancing the fish habitat in the Russian River watershed. The BMPs focus on conserving soil and restoring and sustaining fish habitat on agricultural property. Program participants use a workbook to evaluate and assess their property and current growing practices, and to create a conservation plan for their property. NOAA Fisheries, CDFG, and NCRWQCB review the plan and the site, and the grower can receive certification as a "fish friendly" grower.

4.5.1.2 North Bay Watershed Association

SCWA is also participating in the North Bay Watershed Association (NBWA), which has been created to bring together government agencies within the San Pablo Bay watershed to discuss issues of common interest and concern. Such issues include Total Maximum Daily Load (TMDL) regulations, ESA compliance, habitat restoration, recycled water use, NPDES permits and studies, pollution prevention, source water protection, public education, and others. The NBWA will be a forum to allow local entities to:

- Work cooperatively and effectively with other agencies on watershed-based regulations and issues.
- Explore coordinated efforts on projects to leverage limited funding and resources, thereby decreasing project costs and increasing project benefits.
- Maximize success in securing state and federal grant funding for new watershed initiative programs.
- Efficiently share information about projects, regulations, and technical issues.

The NBWA can serve as a forum to find ways to increase the effectiveness of habitat restoration projects implemented by the participants. A watershed group, such as the NBWA or the Russian River Watershed Association, can seek opportunities to jointly develop habitat restoration projects to reduce costs and increase the ecological benefits to areas important to listed species.

4.5.1.3 Russian River Watershed Council

SCWA has also contributed to a watershed community council within the Russian River watershed region that has been established by the California Resources Agency and USACE. SCWA has provided a meeting place and refreshments, staff time, and other miscellaneous contributions, and has published updates in the *Russian River Bulletin*. The mission of the Russian River Watershed Council is to protect, restore, and enhance the environmental and economic values of the watershed.

4.5.1.4 KRIS/GIS Database

SCWA is contributing to the North Coast Watershed Assessment Program (NCWAP) by developing the Klamath Resource Information System (KRIS) coverages and developing selected Geographical Information System (GIS) layers for several watersheds on the North Coast, including the Russian River watershed. The KRIS/GIS will develop management tools for NOAA Fisheries and CDFG that facilitate salmon and steelhead conservation and recovery planning in NOAA Fisheries' North-Central California Coast Recovery Planning Domain ("planning domain").

The KRIS is a Windows®-based or Internet-based computer program that allows easy access to data tables, charts, photographs, and bibliographic materials relevant to fisheries, water quality, and watershed management. The KRIS can be adapted to any watershed to track factors that affect fish production and water quality over time and across watershed locations. ArcView GIS projects are an integral part of the KRIS program. GIS provides spatially referenced information that is displayed graphically and can be overlaid in conjunction with other spatial or temporal information. GIS "layers" are used in the KRIS to develop overlays and facilitate analysis of factors potentially limiting salmon and steelhead conservation and recovery.

The North Bay KRIS/GIS will provide an organized and easily-accessible computer-based collection of technical information that can be used by NOAA Fisheries and CDFG as well as other groups working in the region to assist in the definition, implementation, monitoring, evaluation, and adaptive management of measures intended to increase the numbers of naturally reproducing salmon and steelhead in the planning domain. The project will incorporate existing GIS data layers pertinent to salmon and steelhead recovery as well as develop new layers to augment the recovery planning process. Existing digital and nondigital databases, relevant watershed literature, and bibliographic reviews will be reviewed and compiled to identify pertinent data that need to be digitized and/or incorporated into the KRIS information management tools. Data layers identified as necessary for evaluating salmon and steelhead restoration, conservation, and recovery planning efforts will be digitized and incorporated into the KRIS projects based on priorities established by CDFG, NOAA Fisheries, NCRWQCB, and other applicable state and local organizations in the planning domain. The project will be coordinated with other ongoing GIS and KRIS efforts in the planning domain to avoid duplication of effort.

SCWA is providing funding for the KRIS/GIS project, while the NCRWQCB will be responsible for managing the program in coordination with California Resources Agency watershed assessment methods and needs. By filling the gaps in drainage coverage and developing a unified platform for data review, analysis, and manipulation, consistent with other similar projects in Northern California, the North Bay KRIS/GIS will facilitate salmon and steelhead conservation and recovery planning by NOAA Fisheries and CDFG.

4.5.1.5 Restoration Project Database

SCWA is funding a project for the NCRWQCB to develop a database of potential restoration projects in the Russian River watershed. The database is intended to identify specific projects that will enhance the quality of surface waters within the Russian River watershed to benefit listed and unlisted aquatic and terrestrial species.

In cooperation with local agencies, watershed groups, and stakeholders, including CDFG and the Sotoyome Resource Conservation District, the NCRWQCB determines what mitigation, enhancement, or water quality improvement projects are currently being proposed, are under development, or may be needed to increase recovery and protection of the listed and unlisted species in the Russian River watershed. The NCRWQCB inventories and prioritizes these projects in the *Russian River Watershed Restoration Potential Projects Database* for use by local agencies in determining which projects will protect and speed the species' recovery. Development of this database will aid in coordinating project implementation on a watershed or sub-watershed basis, with the goal of improving water quality and habitat conditions in the most timely and efficient manner. NCRWQCB began development of this database in 1999. The database is intended to be functional and updateable for all users.

4.5.1.6 Invasive Plant Species Management

SCWA has funded studies to evaluate the status and control of invasive plant species in the Russian River watershed. These studies will inform other projects and assist with watershed-level planning efforts to control invasive species. In 1998, SCWA funded the initial phases of research into the spread of these exotics. To expand the research, Circuit Rider Productions Inc. and Sonoma State University will continue ongoing experiments and initiate new investigations. SCWA's Invasive Plants Species study has focused on the exotic plant *Arundo donax* (giant reed), which has been spreading rapidly and is threatening the integrity of the Russian River's native riparian community.

When non-native plant species replace native species, the riparian ecosystem that salmonids depend on can be altered. The purpose of the Invasive Plant Species Study is to: 1) determine the influence of the exotic plant species, *Arundo donax*, on the composition of native riparian vegetation and invertebrates along the Russian River; 2) evaluate the response of aquatic insects to native and non-native plant litter deposited in the mainstem and tributaries; 3) identify the most effective methods for eradicating *Arundo*; 4) develop techniques for restoring vegetation in previously invaded riparian areas; 5) map the distribution of *Arundo* in tributary streams; and 6) educate the public about *Arundo* and coordinate and train volunteers for *Arundo* removal and follow-up restoration projects. SCWA contributed $58,000 in labor and materials to this project.

The control and restoration of areas invaded by *Arundo* were the focus of two projects. In the Alexander Valley, *Arundo* was removed from test plots by herbicide and mechanical methods, and these experimental trials indicate that herbicide and tarping are highly effective control methods. The recovery of exotic and native plants within the plots was evaluated and showed that removal of *Arundo* allows rapid natural regeneration of invaded sites. In another location, the success of revegetation techniques after *Arundo* removal was evaluated. Exotic plant species influence on invertebrate population abundance was assessed. A UC Berkeley study found a significant preference by aquatic insects for native vegetation, suggesting the food chain for higher animals is altered in *Arundo*-dominated areas.

In 1998, SCWA funded Circuit Rider Productions Inc. efforts to map the extent of *Arundo* along the mainstem Russian River. The 1999 project extended the mapping effort to the Russian River tributaries. The extent of the *Arundo* infestation was delineated using standard aerial photographs and ground surveys. Information collected during these surveys were entered into a computer database (ArcView GIS software) to generate high-quality maps illustrating the extent of *Arundo* along salmonid-bearing tributaries. This basin-wide mapping and GIS program was completed in fall 2001. The program will track *Arundo* populations, prioritize sites for restoration, and monitor project success. Circuit Rider Productions Inc. has provided workshops and technical sessions to local communities, landowners, and environmental groups on appropriate techniques for restoring native riparian habitat in areas where *Arundo* has been removed.

Since 2001, SCWA has funded Sonoma State University's Department of Environmental Studies and Planning to offer a new course in native plant propagation. Copeland Creek and other salmonid bearing streams in the southern Russian River watershed have substantial reaches with canopy that is either missing altogether or substantially sparser, shorter and more dominated by exotics than is optimal for the instream requirements of anadromous fish. Restoration of habitat for steelhead and other native fish and wildlife species depends on restoration of a native riparian plant community along these streams. The course provides students with education in the practical aspects of plant propagation and related restoration techniques. Using existing expertise and facilities on the Sonoma State University campus, the course supplies the Copeland Creek watershed and other watersheds in the area with native plant materials, plant storage and propagation services.

SCWA funded Sonoma State University on-the-ground restoration actions and scientific studies that improve our understanding of how invasive plan species spread. Moderately-sized (30 x 200 meters) plots of the invasive Tree of Heaven (*Ailanthus altissima)* and sweet cherry (*Prunus avium*) on Copeland Creek were eliminated and the areas were restored with native trees. Invaded and non-invaded creek sections were studied to assess effects of these nonnative species on steelhead habitat quality.

4.5.1.7 Federal and State Recovery Planning

The ESA requires development of a recovery plan for listed species. NOAA Fisheries is charged with developing a recovery plan for the Northern California Recovery domain. In north-central California, NOAA Fisheries, CDFG, and local agencies collaborate to provide NOAA Fisheries with support and assistance in fulfilling federal obligations to develop recovery plans. SCWA is providing staff support for the development of an MOU for this effort and is ready to assist as necessary.

CDFG conducts recovery planning for the state coho salmon listing under the California ESA. The State of California initiated a recovery planning process for coho salmon north of San Francisco Bay. SCWA is providing financial and staff support for this effort. SCWA provides support to the State of California to provide a facilitator, technical assistance, and resource economic evaluation. The General Manager of SCWA also sits on the Recovery Team. CDFG completed a Recovery Strategy for California Coho Salmon in 2004 (CDFG 2004). SCWA is providing support to CDFG, the Bodega Marine Lab (BML), and other agencies and organizations in developing a framework for state recovery planning efforts that will facilitate and complement the federal recovery planning effort. SCWA provides technical support to other stakeholders in the development of the strategy, including peer review, additional genetics analysis, evaluation of ocean conditions, and assisting in the development of the guidelines for the recovery strategy.

4.5.2 Riparian and Aquatic Habitat Protection, Restoration, and Enhancement

SCWA began implementation of the FEP in 1996. Since 1996, SCWA has granted funds to various entities each year to provide habitat restoration and research on listed fish species in the Russian River watershed.

In addition to the FEP projects, SCWA has provided funding and staff for research that will facilitate restoration and protection of listed fish species in the Russian River. An important example is SCWA's funding of a project for BML to conduct genetic studies of tissue samples from coho salmon captured in the Russian River watershed. These studies have been used to identify the closest relation of the Russian River salmonids to known population stocks of coho and Chinook salmon. They are being used to help design the coho salmon captive broodstock program at the DCFH. These studies may also be used for genetic analyses of adult salmonids returning to the hatcheries at Warm Springs Dam and Coyote Valley Dam.

SCWA has provided funding and production support for the publication and distribution of a native riparian plant handbook to assist landowners, schools, and community groups with native plant revegetation projects within the Russian River watershed. These efforts reduce streambank erosion and reduce the risk of exotic, invasive plant species being introduced to the riparian habitat. SCWA has provided staff and materials to conduct parcel ownership research in the Russian River watershed. CDFG and SCWA staff will use this landowner contact information to gain stream access for habitat surveys and water quality data collection.

Several specific projects designed to benefit coho salmon, steelhead, and Chinook salmon are described below. In addition to these specific projects, SCWA has funded and/or implemented numerous projects that indirectly benefit coho salmon, steelhead, and Chinook salmon. For example, SCWA has provided funding, staff, and equipment for ongoing clean-up efforts on the Russian River and its tributaries. Those efforts have resulted in the removal of garbage and other materials that could have degraded water quality and habitat quality. These clean-up efforts have also increased community participation in restoration of the Russian River.

A Contingency Fund has been established to provide a source of expertise and materials for small projects not included in the current FEP. There are a large variety of small non-profit groups implementing effective fishery restoration projects in Sonoma County. This fund allows SCWA to provide assistance on a relatively short time frame. The cost of most of these projects is low. For example, SCWA provided $4,535 to fund a 5-year program to teach elementary students about steelhead lifecycle and habitat needs. SCWA funded a restoration project that enhanced 2,500 feet of Austin Creek by installing five boulder wing deflectors, seven log/root wad structures, three willow baffles, and native plants. SCWA funded revision and reprinting of Circuit Rider Productions Inc.'s *Riparian Habitat Guide*.

4.5.2.1 Stream Habitat Surveys

Stream habitat surveys have been conducted in cooperation with CDFG each year of the FEP since 1996, and are intended to assess the habitat conditions of streams that are potentially viable for salmonid production. The goal for this project is to conduct habitat surveys on every stream within the Russian River watershed. All data gathered are entered into CDFG's computer program to prioritize stream restoration projects. These data are available for integration into the KRIS/GIS database. SCWA has allocated staff and materials for this project.

4.5.2.2 Temperature Data Collection

Water temperature monitoring has been conducted each year of the FEP since 1996 to identify streams that provide suitable summer thermal conditions for salmonid juvenile rearing. Because environmental conditions vary annually, an accurate depiction of stream temperature requires data collection in multiple years. Data loggers (i.e., equipment to monitor and record water quality measurements at specific intervals) are removed annually from each stream during the fall and deployed again the following spring. Temperature data have been collected in the Mark West, Maacama, Austin, East Austin, Santa Rosa, Dutch Bill, Hulbert, Dry, Brush, Matanzas, and Big Sulphur creek watersheds. SCWA has allocated staff and equipment for this project. For example, SCWA installed approximately 50 water temperature data loggers in spring 2001. Water temperature data were also collected in the summer and fall of 2002 during a steelhead distribution study (Cook 2003a).

In 2000, SCWA began coordinating its temperature monitoring efforts with the NCRWQCB and other entities, conducting water quality monitoring in the Russian River watershed, including the City of Santa Rosa and Mendocino County. These groups met several times to coordinate placement of temperature monitoring equipment, standardization of techniques, sharing of equipment, and exchange of information. Mendocino County compiles all of the temperature data into a single database. This coordination will allow for more effective monitoring of temperatures in the basin by applying the collective efforts in a more efficient manner, as well as allowing for better comparison of results through standardization of techniques and reporting formats.

4.5.2.3 Water Quality Sampling

This project includes collecting and identifying invertebrates from several streams in the Russian River watershed and analyzing the samples as indicators of water quality. Analysis of the data has entailed sampling of reference streams identified by CDFG for a minimum of 2 years to establish a baseline reference condition. Other streams sampled are compared to those reference streams to determine relative water quality status. This project has been implemented each year since 1996. SCWA contributes staff and materials for the project. Additionally, SCWA provided funding for analysis of samples. Streams assessed include Austin Creek tributaries, Maacama Creek tributaries, the Russian River mainstem, and Mark West, Santa Rosa, Green Valley, Mill, Ackerman, Robinson, Dutch Bill, Hulbert, Fife, Franz, Porter, and Redwood creeks.

4.5.2.4 Russian River Basin Coho Salmon and Steelhead Population Monitoring

Coho salmon and steelhead populations in the Russian River basin have decreased over the last 100 years. However, comprehensive population surveys have never been conducted in the basin, making it difficult to document the decline or accurately track recent population trends. In conjunction with NOAA Fisheries and CDFG, SCWA is planning a basin-wide monitoring program to determine long-term trends in salmonid abundance. Streams throughout the watershed would be sampled annually using a variety of methods including direct observation (snorkeling), trapping, and electrofishing. While the program would generate indices of abundance for all salmonid lifestages (e.g., juveniles, smolts, and adults), SCWA would focus primarily on obtaining population estimates for juveniles during late summer and fall. Consistent environmental conditions during this portion of the year allow access to a large number of sites and increase the repeatability of annual surveys.

SCWA funded a project to develop a study plan for the population monitoring project. Following the second year of the pilot study, SCWA adopted a final plan in consultation with NOAA Fisheries and CDFG and has completed the first 3 years of a pilot study to evaluate methods and sampling sites in the field. During the second year of this project, electrofishing and/or snorkel surveys were conducted in three tributaries of the Russian River, including 68 sites in Santa Rosa Creek, 66 sites in Mark West Creek, 20 sites in Millington Creek, and 122 sites in Sheephouse Creek. Protocols developed after the first 2 years of the study would be used for this project as well as other FEP projects requiring fish surveys. The focus of this project is currently being reevaluated and the objectives of future population studies will likely change to meet the needs of SCWA and cooperating entities.

4.5.2.5 Green Valley Creek Spawning Substrate Characterization

SCWA funded a joint effort between O'Connor Environmental, Inc. and Circuit Riders Productions, Inc. to characterize salmonid spawning substrate and perform a fluvial geomorphic analysis in Green Valley Creek. This investigation collected sediment samples from pool tail outs using McNeil samplers and from adjacent gravel bars to determine sediment size distributions, conducted habitat surveys according to CDFG protocols for habitat units immediately adjacent to sampling sites, measured surface sediment size distributions, and surveyed local channel geometry. The data were analyzed to describe spawning habitat in terms of overall size composition and proportions of fine sediment and the data were synthesized to examine the relationship between local channel conditions and sediment size distributions.

4.5.2.6 Russian River Coho Recovery Stream Monitoring Instrumentation

SCWA funded the University of California, Cooperative Extension, to purchase and install stream stage and stream temperature monitoring equipment to conduct water quality and water quality monitoring as part of the Russian River Coho Salmon Recovery Program's Comprehensive Long-term Monitoring. This project will install instruments in six streams to be stocked with coho salmon and three control streams. The data are critical to determine the success of the recovery program. Stream stage data will be used to determine the timing and intensity of stream flow. Stream temperature data will be used to understand the variability of temperature within and between individual streams.

4.5.2.7 Russian River Habitat Mapping Plan

SCWA funded the E-centers' Mendocino Fisheries Program to map the locations, depths, areas and temperatures of pools in the upper Russian River, map and measure historic salmonid spawning sites, and map the locations of and describe erosion sites. The study encompassed approximately 35 miles of mainstem channel from the east and west forks down to Cloverdale. E-center staff used kayaks to float the study area. Pools were described by a single longitudinal pass using an electronic depth measuring unit along the thalweg. The heads and tails of pools were mapped with GPS units and channel widths were measured with a range finder. Outflow from Coyote Valley Dam was recorded each day. The location and length of spawning riffles and eroding areas were also mapped using hand-held GPS units. Water temperatures were recorded in all mapped units to determine if thermal stratification was occurring in the deeper units.

4.5.2.8 Instream Habitat Improvements

SCWA has funded and/or implemented projects since 1996 to improve habitat in stream channels. Mill, Austin, Turtle, Felta, Green Valley, and Dutch Bill creeks were identified as candidates for instream habitat improvements. Instream habitat structures that have been placed consisted of large woody debris, such as rootwads, that provide protective cover from predators and that promote development of pools. Sites lacking in riparian cover have been planted with trees. A section of Big Austin Creek was reconstructed to convert a braided, intermittent channel to a single thread, perennial stream, with 13,000 square feet of reconstructed spawning area. Additionally, bank stabilization and riparian planting were implemented along Big Austin Creek (see Section 4.5.2.15). SCWA provided matching funds and staff support for these projects. SCWA also provided partial funding to install seven large woody debris structures in six pools along Dutch Bill Creek that provide habitat for coho salmon.

Green Valley Creek is one of the few tributaries in the Russian River watershed that still supports a self-sustaining, although diminished, population of naturally-spawning coho salmon. Surveys conducted by CDFG showed that Green Valley Creek lacked pool habitat and cover. Completed in 2002, the Green Valley Creek Restoration (Site 1) project increased the amount of pool habitat in the creek by installing four large instream woody debris structures. These structures were in good condition after the winter floodwaters of 2000/2001 and a CDFG biologist observed coho salmon at the enhanced pool. The endangered California freshwater shrimp also occurs at the pool. A restoration project at the Green Valley Creek Restoration (Site 2) included recontouring an eroded bank, installing a willow mattress, and planting 35 native riparian trees, thereby stabilizing and restoring 30 feet of eroding bank. This project was completed in 2002. The Green Valley Creek Restoration (Site 3) project stabilized an eroding bank by constructing a small berm at the base of a drainage swale and recontouring the bank to stabilize the soil. Two wood structures were installed in the creek to enhance pool habitat for salmonids. Approximately five native riparian plants were planted in fall 2001. Both of these projects reduced sediment input to the creek. These two projects were partially funded by SCWA.

4.5.2.9 Riparian Restoration

SCWA has funded and/or implemented projects on Howell and Turtle creeks to exclude livestock from the riparian zone adjacent to the stream, and to replant degraded areas with native vegetation. These projects allow riparian vegetation to reestablish, stabilize streambanks, and decrease animal waste entering the stream. SCWA has provided funding, staff, and materials for these projects. In areas where vegetation has been removed, native trees will be planted to provide vegetative cover for wildlife, and shade and structure for aquatic biota.

The Lytton Creek Riparian Restoration and Education project restored 15 acres of native riparian habitat along a salmonid-bearing tributary to the Russian River. The project restored a degraded riparian zone and converted 4 acres of vineyard back to riparian habitat. In the winter and spring of 2001, 1,200 plants were installed with a 90 percent survival rate in early July of the same year. Restoration effects will be monitored for a 5-year period. The project included an environmental education program that incorporated high school students, landowners, and the community in the planning, design, implementation, and monitoring of the project. This project provided an important opportunity to demonstrate that healthy natural ecosystems can coexist with viable farming practices. Circuit Rider Productions Inc. and Clos du Bois winery implemented the project and SCWA provided $27,936 in matching and in-kind funds.

SCWA provided funding for a study to investigate methods of controlling Pierce's disease through removal of non-native plants that are serving as sharpshooter hosts while maintaining a viable riparian community. The disease attacks cultivated grapes and is transmitted by insects (i.e., sharpshooters). Vegetation on Maacama Creek was removed using hand labor and herbicides. Native trees were planted to provide vegetative cover and to provide habitat for birds and small mammals, as well as to provide shade and recruitment of woody debris into the creek for fish. Removal of targeted riparian understory was completed in 1999 to 2000. Researchers from UC Berkeley conducted insect monitoring for 3 years. Insect trapping found a 50 percent reduction in sharpshooters in riparian-managed areas compared to undisturbed riparian areas. The reduction in sharpshooters was 70 to 99 percent at two other study sites located in Napa Valley. This project demonstrated that selective removal of vegetation can control an insect vector of Pierce's disease while maintaining riparian habitat.

4.5.2.10 Rural Road Erosion Control Project

SCWA provided funding and materials for a project to decrease sediment runoff from 1 mile of steeply graded rural roadway adjacent to Palmer Creek. The project consisted of measures to reshape, grade, and excavate runoff ditches in the existing roadway and resurface it with high-quality crushed blue shale. Undersized culverts were replaced to minimize erosion. A series of rolling dips was graded into the roadbed in an effort to properly drain the road and reduce erosion during heavy rains. In addition, decreasing the sediment load enhanced instream habitat structures on the same stretch of Palmer Creek. The project, also funded by SCWA, was completed in 2001.

4.5.2.11 Hood Mountain Regional Park

This project was implemented to reduce delivery of fine sediment to Santa Rosa Creek from an eroding road adjacent to the stream. The portion of Santa Rosa Creek within Hood Mountain Regional Park provides valuable spawning and rearing habitat for steelhead. During the winter of 1996-97, a landslide on Hood Mountain Trail, adjacent to Santa Rosa Creek, displaced over 300 cubic yards of material. In 1999, the site remained unstable and continued to deliver fine sediment to the stream. SCWA granted FEP funds to Sonoma County Regional Parks in 1998 for the development of engineering plans to stabilize the slide. The project was implemented during the 1999-2000 FEP and provided a comprehensive repair to the cut slope, modified the road surface, and filled gullies.

From 1998 through 2001, SCWA provided staff support, materials, and funding for other components of the Hood Mountain project, including: regrading a road crossing and adding rock baffles to improve fish passage; removal of litter (e.g., chain link fence, 55-gallon drums); and development of a water quality monitoring program to be run by LandPaths staff and local high school students.

4.5.2.12 Brush Creek

This project was designed to maintain the flood conveyance capacity of Brush Creek while improving aquatic and riparian habitats. The completed project enhances available habitat for steelhead and other native fish, amphibians, songbirds, and small mammals along Brush Creek. Brush Creek previously underwent channel modifications to allow conveyance of 100-year flow events and provide flood protection for local homeowners. The project widened the cross-sectional area of Brush Creek to permit the stream to both convey streamflow during a 100-year flood event and provide the area necessary to increase habitat diversity along 1,200 lf of the stream. Overall, approximately 4,500 cubic yards of material was removed from the streambed and banks. After the streambed and banks were graded, a series of restoration and enhancement activities were instituted to provide aquatic and riparian habitat throughout the project area. A meandering low-flow channel was constructed in the streambed. Instream structures such as weirs, deflectors, and suitable substrate material were placed in the river to promote the development of pool and riffle habitats, as well as providing bank stability. Streambanks denuded of vegetation during the sediment removal and grading phase of the project were replanted with native vegetation. SCWA contributed $40,000 of funding to the $287,000 project.

4.5.2.13 Copeland Creek

This project involved construction of cattle enclosure and monument fencing, recontouring heavily eroded streambanks, and revegetation with native riparian species on Copeland Creek. The project site is located on approximately 6,000 feet of Copeland Creek between Roberts/Pressley Road and Petaluma Hill Road. Historically, the project site has been grazed by cattle and horses. Grazing pressures limited vegetation establishment to non-native grasses and forbs, with tree cover limited to a stand of non-native Eucalyptus, some scattered oaks (*Quercus* sp.), and California buckeye (*Aesculus californicus*). Numerous cattle paths crossed the channel, and trampling exacerbated erosion of the banks. Restoration of this section of stream decreased sediment load and improved fish habitat. Fencing was installed to prevent livestock access to the riparian zone. Banks were recontoured to a more stable profile. Riparian vegetation was reestablished along the streambanks to provide stability and shade. This project began in 1999 and implementation was phased over several years. Restoration of the final 1,000 feet of degraded creek was completed in 2003. Monitoring of fish, wildlife, and habitat began in winter 2001 and is scheduled for at least 5 years. SCWA provided staff support, materials, and funding for this project.

4.5.2.14 Howell Creek Livestock Exclusion Fencing and Riparian Enhancement

This project excludes cattle from the riparian zone along 4,000 feet of Howell Creek, a tributary of the Russian River, in Mendocino County. A 1998 stream inventory conducted by CDFG indicated that riparian vegetation and stream channel conditions were degraded due to unrestricted cattle grazing in this reach of Howell Creek. This section of stream provided only marginal habitat for steelhead. Healthy riparian vegetation is necessary to improve the condition of the streambanks and bed in this reach. Barbed wire fence was installed and off-stream water sources were developed to eliminate the intrusion of cattle into the riparian zone. Native riparian vegetation was planted in the project site to facilitate recovery. SCWA is providing $14,232 in funding for this project.

4.5.2.15 Big Austin Creek

This project reconstructed 1,300 feet of braided, intermittent channel to a single-thread channel, perennial stream with 13,000 square feet of reconstructed spawning area. The project also included bank stabilization and riparian vegetation planting along sections of the stream channel. Prior to the project, a series of shifting channels flowed through an area known as “King’s Flat.” Large amounts of bedload from old mining tailings located upstream of the project area caused excessive aggradation, resulting in a braided multichannel stream. By restoring the stream to a single channel, fish habitat is greatly improved. Stream sections with highly eroded banks were stabilized with rock, rootwads, and live trees. Riparian vegetation was reestablished along the banks to increase cover and help reduce water temperature. Work completed under the 1997 to 1998 FEP Plan included bank stabilization, placement of instream cover, and construction of willow baffles. Work conducted under the 1999 to 2000 FEP Plan included additional stream bank stabilization and riparian vegetation planting. The site has stabilized naturally and a weir originally planned for the site is not needed. Restoration is considered complete and monitoring is scheduled through 2003.

4.5.2.16 Russell Irrigation Site on Turtle Creek

The purpose of this project was to facilitate development of a mature riparian forest, stable streambanks, and improved aquatic and terrestrial habitats. This was accomplished through providing an alternative drinking source for livestock that previously used the stream as a watering source. The landowner for this site previously participated in a voluntary fencing project to exclude the cattle from Turtle Creek. To provide the alternative drinking source for the livestock, a well was removed and repaired, and 2,100 feet of pipe were installed to deliver the water to the cattle. SCWA provided the funding for this project.

4.5.2.17 McNab Creek Restoration Project

SCWA funded the E-centers’ Mendocino Fisheries Program to conduct stream restoration efforts on McNab Creek in Mendocino County. The project consisted of stabilizing stream banks and improving the quality of fish habitat at thirteen sites on McNab Creek. At five sites stream banks were stabilized using bioengineering techniques and at nine sites instream structures such as cross vane weirs and log structures were installed to improve habitat quality. This project was completed in 2001.

4.5.2.18 Mumford Dam Fish Passage and Riparian Restoration

Mumford Dam is a privately-owned, medium-size diversion dam (approximately 60 feet wide and 8 feet high) located on the west branch of the Russian River near the town of Redwood Valley. The dam is used to divert flows for vineyard irrigation and frost protection.

Since the dam’s construction in the early 1900s, the streambed below the dam has down-cut between 8 to 15 feet. This down-cutting eliminated fish passage over the structure, restricting access to approximately 45 miles of spawning habitat. In addition, down-cutting caused massive erosion and bank failure for approximately 600 feet below the dam. This restoration project improves fish passage over Mumford Dam and improves streambank stability and riparian habitat near the dam. The project involved recontouring the streambanks to a more stable profile, constructing a series of weirs to facilitate fish passage, and revegetation with native plants. The dam owner also upgraded the diversion facilities to comply with NOAA Fisheries fish screening criteria. SCWA has provided more than $700,000 in funding for this project and has obtained approximately $500,00 0 in grant monies for this project. SCWA assisted the Simon Partnership (landowners) with engineering design plans, conducted botanical, fish, and wildlife surveys needed for the environmental permitting, and acquired needed permits. Project construction was implemented in the summer of 2003, and revegetation was implemented in the fall of 2003.

4.5.2.19 Crocker Creek Dam

Crocker Creek Dam was located near Asti. When Crocker Creek Dam failed, the impact to Crocker Creek was significant. A large sediment load was released downstream from behind the dam and the creek upstream of the dam experienced major erosion and collapsing banks. While the elevation of the base of the dam was lower than the previous top of the dam, the structure and debris pile posed an impassable barrier to anadromous salmonids. A significant amount of work was done at this site.

The objective of the Crocker Creek Dam removal project was to restore anadromous fish, primarily steelhead, access to the Crocker Creek watershed while stabilizing streambanks in the vicinity of the dam. The project included removal of the remaining dam infrastructure, recontouring the streambanks to a more stabile profile, constructing a series of weirs to facilitate fish passage, and revegetating with native plants.

4.5.2.20 Laguna de Santa Rosa

USACE is conducting a feasibility study to investigate the extent and causes of sedimentation in the Laguna de Santa Rosa (“Laguna”). The Laguna area is a large, gently sloping basin with natural flood retention capability and historic wetland attributes. Historically, it served as a major storm retention basin during periods of flooding. Human development has modified hydraulic and hydrologic conditions in the surrounding area and may be accelerating habitat changes in the Laguna. Siltation from municipal development in the surrounding area and from certain agricultural practices may be reducing the Laguna’s attributes and flood-retention capability.

The Laguna drains a basin of 250 square miles (160,000 acres) that includes the adjacent cities of Cotati, Rohnert Park, Santa Rosa, and Sebastopol. The Laguna transports rainfall runoff from the watershed to the Russian River, and as the water surface elevation in the Russian River rises with increasing flows, water flows back into the Laguna from the Russian River. The Laguna is considered to be an important factor in lowering the water surface elevation in the lower Russian River floodplain.

The results of the initial sedimentation studies will determine which, if any, alternatives are investigated for the possibility of management and restoration measures. To reduce the negative effects of sedimentation on the Laguna's flood control capacity and habitat, such measures could include:

- Watershed management. This could involve identifying sediment reduction alternatives; conducting a topographic survey to compare past data and as a baseline for future studies; inventorying stream channels; analyzing air photos; and using historic and current information to determine local sources of sediment affecting the Laguna.

- Channel restoration. This could involve identifying and characterizing flood control channels within the Laguna; identifying and evaluating structural flood detention alternatives; and identifying and evaluating flood protection.

- Habitat restoration. This could involve identifying and characterizing opportunities to restore historic wetlands for optimum diversity and long-term sustainability.

4.5.2.21 Santa Rosa Creek

The City of Santa Rosa is undertaking a project to restore Santa Rosa Creek by returning the channelized creek reaches to a more natural geomorphic and ecological form and function and improving water quality, while maintaining existing levels of flood protection. The USACE, SCWA, and Sonoma County are assisting the City of Santa Rosa with project development or implementation. The restoration is also intended to benefit steelhead and other aquatic life.

Initially, the City of Santa Rosa (the nonfederal sponsor) requested that the USACE conduct an investigation to determine whether there was a federal interest in an ecosystem restoration project along the creek**.** A 1997 Reconnaissance Report that investigated the Russian River and tributaries concluded it was likely that an ecosystem restoration project would be in the federal interest. USACE and the City of Santa Rosa developed a project study plan and subsequently executed a cost-sharing agreement to initiate the current Santa Rosa Creek Ecosystem Restoration Feasibility Study.

During the initial phase of the study, there was uncertainty about whether the existing flood-control project had adequate capacity for a 100-year-flood event due to floodplain development and environmental changes in local conditions since the project was constructed in the early 1960s. A draft hydrologic analysis, conducted by USACE in August 2002, concluded that improved and unimproved channels within the watershed would experience flows during a 100-year-storm event significantly greater than anticipated by the original design documents for those facilities. USACE determined that flood-damage reduction was an appropriate purpose under the existing authorization for the Feasibility Study (i.e., the Water Resources Development Act of 1996). Thus, additional tasks were identified and incorporated into the study, now the Santa Rosa Creek Ecosystem Restoration Feasibility Study.

The Santa Rosa Creek Master Plan was signed on September 21, 1993 by the City of Santa Rosa, the County of Sonoma, and SCWA (Santa Rosa, City of, County of Sonoma, Sonoma County Water Agency 1993). In the City of Santa Rosa Master Plan, the 12.8-mile-long project has been divided into seven reaches, distinguished by vegetation, hydrology, adjacent land use, ownership, channel morphology, and access. Reaches A and B, which are between Highway 12 near Los Alamos Road and E Street, are characterized as natural channel. The vegetation represents a mature, native riparian community. This area is in private property ownership with limited access. Commercial, residential, and undeveloped land uses are located adjacent to the creek. Reaches C, D, and E, are between E Street and Piner Creek west of Fulton Road. They are characterized by a relatively steep, trapezoidal-shaped channel with grouted rock in Reach C and riprap in Reaches D and E. There is very little riparian vegetation. SCWA owns the two maintenance roads on either side. Adjacent land use is commercial, residential, and industrial. The Rural Reaches F and G are between Piner Creek and the Laguna. These reaches are characterized by a wider and shallower channel with more sediment bars, less riprap (none in Reach G), and some riparian vegetation. There are levees in Reach F and maintenance roads along both sides of the creek in both reaches. The adjacent land use is agriculture and floodplain. The boundaries of the proposed restoration project include part of Reach C (Pierson Street to Dutten Street) and all of Reach D through Reach G. No action is proposed for Reaches A or B.

The project is currently in the planning and permitting phase. Several alternatives are being considered, which are discussed below. The selected alternatives will be implemented in the project area. The action alternatives include restoring habitat and improving water quality by implementing one or more of the following restoration types in the various reaches of Santa Rosa Creek (Santa Rosa, City of, County of Sonoma, Sonoma County Water Agency 1993):

> *Type 1 Channel Restoration:* Enlarge channel capacity by removing existing grouted riprap, replacing the southern bank with a steeper, engineered wall system that allows for vegetative growth, and stepping the north bank with a series of retaining walls that allow for multiple use, and pedestrian and maintenance paths. A soft, naturalized creek bottom will be vegetated with native riparian grasses, sedges, and shrubs. This restoration measure is proposed for sections of Santa Rosa Creek between Santa Rosa Avenue and Pierson Street.
>
> *Type 2 Channel Restoration:* Enlarge the channel capacity by removing the existing riprap, laying back the southern bank to a more stable angle, and terracing the northern bank to allow for path installation. The newly constructed channel will be vegetated using native riparian species. The creek bottom will provide a soft, meandering low-flow channel, which will be shaded and feature rocks and anchored logs for fish habitat. This restoration measure is proposed for sections of Santa Rosa Creek between Pierson Street and Piner Creek.
>
> *Type 3 Channel Restoration:* Enlarge channel capacity and expand the existing cross-sectional area of the creek by removing existing riprap, laying back one bank, and excavating the other bank to create vegetated terraces on which paths would be placed. The entire creek channel will be revegetated with native riparian

plant materials. This restoration measure is proposed for limited sections of Santa Rosa Creek between Stony Point Road and Piner Creek.

Type 4 Channel Restoration: Increase the channel width by relocating one or both levees away from the creek a total of not more than 100 feet. The creek channel would be re-contoured to create a naturalized meander pattern with riparian plantings throughout. This restoration measure is proposed for sections of Santa Rosa Creek between Piner Creek and Willowside Road.

Type 5 Channel Restoration: The area of riparian vegetation would be expanded by 100 feet or less between Willowside Road and Laguna de Santa Rosa to enhance the riparian vegetation and to allow the development of a meandering low-flow channel.

In Measures 1 through 5, rocks would be placed in the creek to create pools, riffles, and runs, and define the low-flow channel. In addition, anchored logs with root wads exposed to the creek will be installed. These features will enhance the structural diversity of the channel bottom and improve fish habitat. SCWA is currently implementing some of the components in the Santa Rosa Master Plan.

4.5.2.22 Dry Creek

Gravels used by coho salmon for spawning are smaller than those used by steelhead or Chinook salmon (Kondolf and Wolman 1993). As discussed in *Interim Report 1*, the high flows in Dry Creek may more readily transport coho salmon gravels out of the upper reach (ENTRIX, Inc. 2000a).

SCWA would construct habitat improvement structures using boulders and redwood or fir trees at suitable locations in Dry Creek to increase habitat complexity and available cover, and provide areas that hold gravels used by coho salmon for spawning. Structures would have to be quite large to remain in place and be effective at trapping these gravels. The structures would typically consist of three or four, 3- to 5-ton rocks and a tree with attached limbs and root ball. Individual trees would be at least 18 inches in diameter and 35 to 40 feet long. The structure would resemble a grounded sweeper and debris pile along the channel margin. Debris clusters would be anchored in place by burying the downstream end of the tree and placing a large rock on top of the back-filled excavation. Two large boulders would hold the root ball in place. These structures may require periodic maintenance/modification of the debris to maintain its effectiveness. Initially, root wads or other structures would be placed at intervals of 500 feet, on average, providing approximately 150 structures along a 14-mile length of channel. These would not be placed at even intervals, but rather clustered in areas where geomorphic conditions and access afford the best opportunities.

Large woody debris or other structures placed in the stream channel may reduce channel capacity and increase the risk of flooding and/or bank erosion. Large woody debris may slow or alter currents in a way that could increase the potential for flooding of adjacent land. These instream structures could, in some cases, redirect flows to streambanks and encourage bank erosion. Therefore, placement of large woody debris would require establishment of an expanded riparian zone for flood protection and education of the public regarding the benefits of this action. If structures placed in the stream become mobile, they may cause flooding due to obstruction of flows. The effectiveness of this action is related to the number of locations where it can be implemented. While a larger number of structures would promise greater habitat gains, restricted stream access and the need to obtain permission from landowners may constrain the number of sites where structures could be placed.

Purchase of conservation easements would be required to fully implement some of these actions.

4.5.2.23 Gold Ridge Stewardship Program

The Gold Ridge Stewardship Program enhances fisheries habitat and water quality through coordination of watershed restoration and stewardship efforts. The Gold Ridge Resource Conservation District promotes the formation of watershed groups for community members through education, outreach, and identifying priority watershed issues. SCWA provided matching and in-kind funds. In 2000-2001 the stewardship program published two newsletters and hosted a rural roads workshop. The rural roads workshop was presented by Pacific Coast Watershed Associates and discussed proper installation and maintenance of private dirt roads to minimize erosion and runoff into streams.

The Gold Ridge Resource Conservation District organized clean-ups in the Green Valley and Dutch Bill Creek watersheds with local watershed groups, schools, and other local groups and agencies. The purpose of the Gold Ridge Creek clean-ups is to minimize pollution and obstructions to fish passage, improve creek aesthetics, and distribute educational materials. The clean-ups are supplemented by the distribution of educational materials to landowners regarding the effects of pollution on fisheries and water quality.

4.5.2.24 Riverfront Park Reclamation

SCWA and the Sonoma County Agricultural Preservation and Open Space District (“Open Space District”) together purchased property from Hanson Aggregates Mid-Pacific, Inc. The 304.62-acre property will be used for preservation of open space, a public park, and for water education purposes. The SCWA Riverfront Park property is located adjacent to the Russian River in north-central Sonoma County at 7821 Eastside Road. Located on the floodplain terrace of the Middle Reach of the Russian River, the property was used for terrace-pit gravel mining (Figure 4-4). Three pits have filled with water and are now referred to as Lake Benoist (67 acres), Lake Wilson (37 acres), and Lake McLaughlin (23 acres). The property also contains a graded area (the McLaughlin Pad), which was the site of gravel processing operations. As part of the mining operations, the topsoil was previously stripped from the McLaughlin Pad and stockpiled on-site for future reclamation purposes.

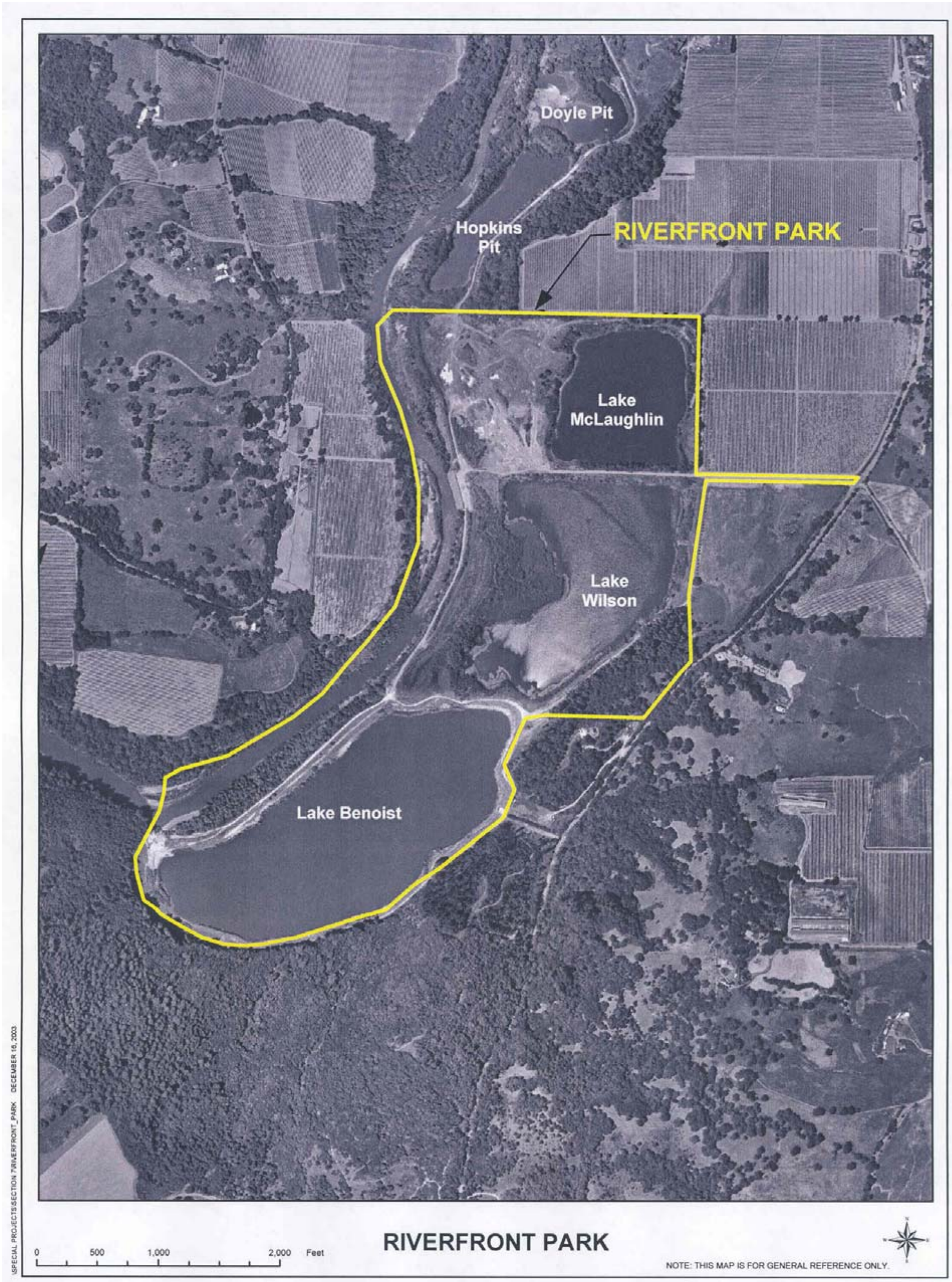

Figure 4-4 Riverfront Park Area Map

There is a potential for salmonids to be entrained in these lakes when water levels recede after high-flow events. This entrainment potential existed before SCWA acquired the property. There are levees on the riverbank next to the property, but flood water can flow through an opening in the riverbank at the Doyle Pit located to the north of Lake McLaughlin (Figure 4-4) and flood adjacent property. Flow can enter Lake McLaughlin at several locations through the berm at the north end of the lake. Floodwaters can also flow from the northwest when the river overtops the banks. Water also flows to Lake Benoist through a rock riprap weir at the southern end of the lake, and floodwaters can back up into Lake Wilson and Lake McLaughlin. At high-flood flows, the entire area can be under water.

River water that crests the bank at the Doyle Pit and flows into Lake McLaughlin provides a potential conduit for fish passage. A berm with an average elevation of approximately 71 feet on the north side of the McLaughlin site prevents floodwater from flowing directly into Lake McLaughlin from the north. However, floodwaters, as well as overland flow, can flow through culverts through the berm. Flow from the property to the north (particularly from the terrace at two locations in the vicinity of the Hopkins and Doyle pits) can flow through two 8-foot culverts located on the northeast corner of the lake, and through a 3-foot culvert on the northwest corner of the lake that drains approximately 5 acres of vineyard.

Aerial topography and field inspection show that the two 8-foot culverts drain approximately 23 acres, and the remainder drains through a vineyard swale into the Doyle pit (Murray, Burns, and Kienlen 1999). Water can flow through a low area adjacent to the Doyle Pit located at the northeast corner of Lake McLaughlin. When the terrace near the Hopkins and Doyle pits to the north of Lake McLaughlin reaches a flood stage of 63.5 feet (1.75-year return interval or 28,000 cfs at Healdsburg), flow is directed through two swales toward the McLaughlin culverts.

Floodwater from the river flows through the weir at Lake Benoist. The top of the weir is at an elevation of approximately 53.0 feet, and fish passage can only occur when water flows over it. When Lake Benoist is full, water flows into Lake Wilson over the land bridge between the lakes. An abandoned haul road embankment separates McLaughlin and Wilson lakes. Water flows into Lake McLaughlin when floodwaters overtop the lowest perimeter elevation between the Lake McLaughlin and Lake Wilson banks, which is approximately 60.5 feet (NGVD) at the southwest corner of Lake McLaughlin (1.25-year return interval).

Hydraulic analysis at the site indicates that the riverbank at Lake McLaughlin can be expected to overtop at approximately a 2-year average return interval. The lake and surrounding landscape are completely inundated at an elevation of 71 feet (generally a 10-year-flood event).

When flood flows recede, Lake McLaughlin drains into Lake Wilson. All three lakes eventually drain back to the Russian River through the weir in Lake Benoist and via ground percolation. During the summer, Lake Benoist is the deepest of the three lakes with a depth of over 50 feet.

SCWA is preparing plans for reclamation of the property to return the site back to wildlife habitat consistent with the intent of the site-specific 1995 Master Reclamation Plan. The reclamation work would include surface regrading and replacement of topsoil over the McLaughlin Pad, repair of erosion damage at the two-way spillways between the lakes, construction of the levee closure between McLaughlin and Wilson lakes along the Russian River, and installation of native vegetation to create wildlife habitat on the site. Reclamation work will be coordinated with Sonoma County Regional Parks Department's plans to incorporate initial trails and enhance access to portions of the property. Contract drawings for a reclamation construction project would be prepared in 2004 with construction scheduled for completion by the end of 2004.

4.5.2.25 Best Management Practices for Restoration Projects

BMPs used are site-specific, but, in general, SCWA follows the procedures outlined in the CDFG Fisheries Habitat Restoration Program. With few exceptions, SCWA projects are not built on "live" streams. Most can be constructed during a period when the stream is dry. In most cases, if not all, work in a wet stream channel would require a permit from USACE, and the terms and conditions of that permit would dictate the practices used to minimize effects. For example, on Austin Creek reconstruction of the toe of the bank was necessary, and the BMPs used were those stipulated by the USACE permit. A combination of detention basins, hay bales, and filter fabrics were used, and no sediment problems were identified. On Adobe Creek (not in the Russian River Basin), SCWA built a fish passage (with a series of boulders) in an active stream, and fish rescues were conducted to move as many fish as possible out of the project area.

SCWA strives to avoid any effects to the streams or listed species while implementing restoration projects. Details for specific projects to be constructed have been provided where they are known.

Table 4-8 summarizes information about actions that are part of the proposed actions and, where known, indicates the listed fish species the action is likely to affect. Steelhead are the most abundant species in many of these areas, but as coho or Chinook salmon populations are recovered, use of these streams by these species is likely to increase. All projects listed are likely to improve habitat for spawning, rearing, and migration of listed salmonids. Restoration actions that are part of the proposed actions and have been implemented since the time the MOU was signed represent an improvement to baseline conditions and do not require a take authorization. Actions that require take are projects that will be implemented and may have direct effects on listed species during construction. They are usually projects that require instream work while listed fish species may be present. BMPs to minimize adverse effects are generally outlined during the permitting process.

Table 4-8 Summary of Restoration and Conservation Actions that are Part of the Proposed Actions

The size of the project is the actual length of stream affected. A "+" indicates projects that have effects that may extend well beyond the immediate project area.

Creek	Type of Project	Size of Project	Species Affected[1]
PART OF THE PROPOSED ACTIONS (NO TAKE STATEMENT REQUIRED)			
Instream Habitat Improvements			
Dutch Bill	7 habitat structures	6 pools	Co, St
Mill	14 sets instream habitat structures	~ 2 miles	St
Felta	14 sets instream habitat structures	~ 2 miles	Co, St
Green Valley	Four instream habitat structures		Co, St
Riparian Restoration			
Copeland	Fencing, grading, riparian planting	6,000 ft	St
Copeland	Propagation of native plants and control of invasive non-native plants		St
Green Valley	Erosion control and riparian planting		Co, St
Howell	Fencing	4,000 ft	St
Lytton	Riparian planting with environmental education	14 acres	St
Turtle	Willow walls & mattresses	500 ft	Co, St
Turtle	Irrigation	> 1 mile	Co, St
Felta	Willow walls	3 projects	St
Russell Irrigation site on Turtle Creek	Fencing, cattle removal	> 1 mile	Co, St
Unnamed - Huff property	Willow wall		Co, St
Instream and Riparian Restoration			
Austin	5 boulder wing deflectors, 7 log/root wad structures, 3 willow baffles, native plants	2,500	St
Brush	Streambed and bank regrading, instream structures, revegetation	1,200 ft +	St
Big Austin	Reconstruct channel	1,300 ft	Co, St
Big Austin	13 erosion control/riparian structures – willow baffles, willow wall, slide repair	0.5 mi. +	Co, St
Green Valley	Erosion control, revegetation, two instream habitat structures		Co, St
McNab	5 streambank stabilization sites and 9 instream structure sites		St
Palmer	Instream habitat structures	3,000 ft	St
Santa Rosa Creek	Restore channelized creek to more natural form and function	12.8	St

Table 4-8 Summary of Restoration and Conservation Actions that are Part of the Proposed Actions (Continued)

The size of the project is the actual length of stream affected. A "+" indicates projects that have effects that may extend well beyond the immediate project area.

Creek	Type of Project	Size of Project	Species Affected[1]
PART OF THE PROPOSED ACTIONS (NO TAKE STATEMENT REQUIRED)			
Rural Road Erosion Control			
Palmer	Erosion control, instream structures	1.5 +	Co, St
Santa Rosa (Hood Mt.)	Road and landslide erosion control	100 yds +	Co, St
Fish Passage			
Santa Rosa (Hood Mt.)	Rock weirs at stream crossing	10 miles upstream habitat	Co, St
PROJECTS THAT MAY REQUIRE TAKE AUTHORIZATION			
Instream Habitat Improvements			
Dry Creek	Instream habitat structures	14 miles	St, Co, Ch
Palmer	Instream habitat structures		St
Fish Passage			
Mumford	Engineering design plans, surveys for environmental permitting	50 miles upstream habitat	Co, St

[1]Co = Coho salmon, St = Steelhead, Ch = Chinook salmon

4.5.3 WATER CONSERVATION AND RECYCLED WATER

SCWA has completed a preliminary assessment of urban water reuse to evaluate the feasibility of recycled water projects. The assessment addressed the following elements of water conservation and recycled water use:

- The potential reduction in peak demands on the water supply system that could be realized through the expanded use of tertiary-treated recycled water for irrigation.
- The potential reduction in annual water supply demands from expanded use of tertiary-treated recycled water.
- Order-of-magnitude costs (within 30 percent to 50 percent of actual cost) for construction and operation of recycled water distribution systems in urban areas.

In addition to the preliminary assessment for urban recycled water projects, SCWA is participating in a feasibility analysis of a storage and distribution system for the agricultural use of recycled water from the City of Santa Rosa's Geysers Pipeline. This project would provide recycled water to agricultural users in the northern portion of Sonoma County. The water source is recycled water produced by local wastewater treatment facilities that is in excess of the amount that has been committed to other existing uses.

4.5.3.1 Recycled Water Feasibility Study

Background

SCWA provides a wholesale potable water supply for eight water contractors. The use of recycled water for irrigation in urban areas has the potential to reduce the peak summer demands on SCWA's water supply system. During the peak water demand periods, SCWA's water supply system is currently operating at capacity.

Scope of Assessment

A preliminary assessment of urban reuse was performed, primarily using existing sources of information provided by SCWA's water contractors. SCWA staff compiled and/or generated the necessary project components for the urban reuse projects and applied consistent cost estimates to each project. The cost estimates presented in the assessment represent order-of-magnitude estimates and are intended to allow comparisons of the costs and benefits of the various projects.

Although these cost estimates can be used for preliminary planning purposes, a second-phase feasibility study of potential water reuse would provide a more accurate representation of the necessary components of urban water reuse systems and associated costs. This additional evaluation should include, but not be limited to, computer modeling of the pipeline systems, field surveys of potential pipeline routes, environmental concerns, and evaluation of the existing recycled water irrigation systems.

An assessment of the amount and location of recycled water releases is being developed, but is not available at this time.

Results of Study

Based on the results of a reconnaissance-level study, it appears that the expanded use of recycled water use for irrigation within SCWA's service area could reduce both annual and peak potable water demands from the transmission system. It is estimated that not only could 2,300 AF of water be saved on an annual basis, but also the peak average monthly flow would decrease by approximately 5 mgd.

4.5.3.2 Agricultural Use of Recycled Water in North Sonoma County

SCWA, in cooperation with the U.S. Bureau of Reclamation (USBR), local agricultural water users, and local wastewater agencies, is assessing the feasibility of a storage and distribution system for the agricultural use of recycled water from the City of Santa Rosa's Geyers Pipeline that is more than the amount that has been committed to the Geysers Recharge Project and other existing uses. The proposed project will require the negotiation of agreements between the parties for project design, water delivery, and project financing.

This reuse of recycled water would improve the reliability of the water supply for agricultural purposes in North Sonoma County. The project would also assist SCWA with the development of solutions to address water supply, environmental, and regulatory concerns.

4.6 FISH FACILITY OPERATIONS

Under the proposed project, USACE will continue to fund operations of the DCFH and CVFF fish production facilities. The existing steelhead mitigation program will continue operating as an isolated harvest program, as described in the environmental baseline discussion of Section 3.8, incorporating operational changes that have been implemented due to revisions in CDFG policy and guidelines. A coho salmon integrated recovery program, initiated by CDFG and NOAA Fisheries in 2001, would be conducted at DCFH; this program would replace previous baseline production goals for coho salmon mitigation and enhancement. USACE expanded the DCFH facility in 2003 to accommodate current needs for the coho salmon integrated recovery program, and additional expansion facilities are expected to be built in 2004. No production of Chinook salmon is presently proposed. Results of proposed fisheries monitoring efforts and genetic tissue sampling will be evaluated on a routine basis to determine whether operations should be modified in the future to accommodate supplementation of the wild population for Chinook salmon integrated recovery and/or steelhead integrated harvest programs. Additional structural modifications are proposed at DCFH that would enhance overall function for all programs, regardless of species.

This section begins with a summary of changes in fish facility operations implemented since the end of the environmental baseline period in 1998. The section then presents the goals and objectives of the two proposed fish production programs, followed by a more detailed discussion of each program. Structural modifications that would enhance both programs are discussed separately. Finally, there is a detailed discussion of the two future alternative programs that may be implemented, depending on the results of future monitoring efforts.

4.6.1 AUTHORIZED PROGRAM CHANGES SINCE 1998

In October 1999, a meeting between USACE, CDFG, and NOAA Fisheries established an interim operations plan for the 1999-2000 operating season at DCFH and CVFF. This plan called for the cessation of hatchery production of coho and Chinook salmon in the basin. Steelhead production goals remained unchanged from the original goals. The plan revised the steelhead spawning protocols by specifying that only returning adult hatchery steelhead are to be used for broodstock, and that no wild steelhead are to be used as broodstock. In April 2000, the same agencies agreed to continue the interim operations plan until additional data were available regarding the genetic make-up of fish returning to the hatchery and those found in the wild (Interim Operations Memoranda; J. Christensen, pers. comm. 1999; Joint Hatchery Review Committee 2000).

In May 2001, CDFG submitted a permit application to NOAA Fisheries proposing a pilot program to analyze the effectiveness of a captive broodstock program for coho salmon in the Russian River. NOAA Fisheries issued a BO on August 31, 2001, approving the pilot program under Section 10 (a)(1)(A) of the ESA, which authorized “take” for the purposes of scientific research or enhancement activities. The BO authorizes the pilot program through June 2007, to allow time for adequate implementation and analysis of the enhancement response (NMFS 2001c). The program is an integrated recovery program that will rear juvenile coho salmon collected in the Russian River, use them as broodstock, and then seed progeny into streams in the lower Russian River basin.

4.6.2 PROPOSED FISH FACILITY PROGRAM GOALS

The proposed project for steelhead maintains the existing isolated harvest program, unless the results of future monitoring efforts and genetic analyses of steelhead residing in-river and above the dams indicate that an integrated harvest program would be more appropriate. The proposed project for coho salmon is a continuation of the coho salmon captive broodstock integrated recovery program, to be extended as necessary beyond the current expiration of 2007. No Chinook salmon production is proposed at this time, but a future alternative supplementation program may be implemented if warranted.

Under the proposed project, the existing mitigation and enhancement goals for coho and Chinook salmon will be put on hold for an interim period. The mitigation obligations of USACE for coho salmon, steelhead, and Chinook salmon will be formally revised to provide objectives that are realistic and feasible under current environmental and regulatory conditions. A monitoring program will be implemented to evaluate the effectiveness and performance of hatchery operations and the results of population status monitoring programs conducted by others will be tracked closely. Hatchery operations will incorporate adaptive management practices, which could lead to changes in hatchery production guidelines (such as number of juveniles released, size of juveniles released, or use of wild fish for broodstock) based on monitoring program findings.

Several alternative fish production programs were evaluated in the course of selecting the proposed project options. The results are presented in the Benefit Risk Analysis (BRA) document (FishPro and ENTRIX, Inc. 2002). The BRA considered many factors, including information collected in recent years regarding the status of listed species and habitat conditions throughout the basin, as well as input provided by resource managers, such as NOAA Fisheries and CDFG. The BRA included recommendations for minimum numbers of broodstock to use for each program, as a means of minimizing potential genetic effects on both the hatchery and wild fish populations.

Program goals for the proposed project are summarized in Table 4-9, indicating the program type, release numbers, and minimum numbers of broodstock to use for spawning. More detailed descriptions of the proposed programs are presented in Section 4.6.3 for steelhead and Section 4.6.4 for coho salmon. These descriptions are adapted from the Draft Hatchery and Genetic Management Plans (HGMPs) (FishPro and ENTRIX, Inc. 2003) developed to support this consultation process. The HGMPs provide detailed information on the proposed steelhead and coho salmon programs in a specific format that enables NOAA Fisheries to conduct efficient analyses of the programs.

Table 4-9 Proposed Annual Program Goals for Russian River Hatchery Production

Location / Species	Type of Program[1]	Juvenile Releases	Broodstock Spawning Numbers[2]
Don Clausen Fish Hatchery			
Steelhead	Isolated harvest	300,000 yearling	720
Coho salmon	Integrated recovery	100,000 advanced fingerling	300 - 600
Chinook salmon	None (until status is determined)	0	0
Coyote Valley Fish Facility			
Steelhead	Isolated harvest	200,000 yearling	480

[1]As defined in NOAA Fisheries' current template for Hatchery and Genetic Management Plan (HGMP), available at www.nwr.noaa.gov, an *isolated harvest program* is "a project in which artificially propagated fish produced primarily for harvest are not intended to spawn in the wild or be genetically integrated with a specific natural population." An *integrated recovery program* is "an artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), and fish produced are intended to spawn in the wild or be genetically integrated with a targeted natural population(s), sometimes referred to as 'supplementation.'" It is assumed that an *integrated* program is more desirable than an *isolated* program as a means of minimizing potential genetic effects; however, the risk cannot be evaluated until current evaluations of genetics and stock origin are completed. Original mitigation and enhancement goals took into account harvest activities on all species; however, harvest is currently permissible only for hatchery steelhead. A continued harvest is assumed as a long-term goal for the steelhead program based on apparent stability of the hatchery stock. A recovery goal is assumed for the coho salmon program, which has already begun implementation of a restoration program to avoid the risk of extinction.

[2]Broodstock spawning-number goals reflect the estimated minimum number necessary to achieve juvenile release goals, or the minimum necessary to maintain genetic integrity, whichever is greater. The steelhead broodstock numbers incorporate the current spawning protocol of using 2.5 males for every 1 female.

4.6.3 Steelhead Isolated Harvest Program

The current uncertainty regarding genetic divergence that may have occurred between the natural and hatchery steelhead stocks within the Russian River basin provides justification for an "isolated" program.

The proposed isolated harvest program for steelhead would continue the objectives of the existing steelhead mitigation program. The program would collect returning hatchery-reared steelhead and use them as broodstock to produce fingerling. The fingerling would be subsequently released as smolts directly in Dry Creek, or transported to CVFF for acclimation and volitional release in the upper Russian River basin. The objectives of the isolated harvest mitigation program are to: 1) compensate for the loss of steelhead production behind Warm Springs Dam and Coyote Valley Dam; 2) provide a fishery for hatchery-reared steelhead in the Russian River basin; and 3) minimize ecological interactions with the wild Russian River steelhead population by purposefully striving to isolate the spatial and temporal overlap of habitat utilization by the wild and hatchery-reared components.

The time-frame necessary to measure and evaluate the objectives is estimated to be a minimum of three generations, so that a statistically significant number of samples can be obtained for analysis. For the isolated harvest alternative, this time-frame is estimated to be 15 years, assuming 5 years to be the average length of a steelhead generation.

4.6.3.1 Broodstock Selection and Mating

The isolated harvest program would derive all broodstock from the supply of adult steelhead returning to the hatchery. Broodstock for the DCFH program are collected from fish returning to the DCFH ladder and trap, while those for the CVFF program are collected from fish returning to the CVFF ladder and trap. All wild adult steelhead returning to DCFH are relocated to tributary streams of Dry Creek, and all wild adult steelhead returning to CVFF are relocated to the west branch of the Russian River above Mumford Dam or on the East Fork near Forsythe Creek. In a change to past protocols, all surplus hatchery adult steelhead returning to the fish facilities would not be returned to the watershed, but would be destroyed to minimize potential interactions with naturally-spawning fish. Table 4-10 summarizes the proposed annual broodstock spawning numbers for steelhead.

Table 4-10 Proposed Annual Broodstock Minimum Spawning Numbers for Steelhead

	DCFH	CVFF
Females	180	120
Males (including jacks)	450 (incl. 3 jacks)	300 (incl. 2 jacks)

4.6.3.2 Rearing and Release

Proposed rearing operations for the steelhead program would continue the methods currently practiced, as described in Section 3.8. The proposed annual fish-release levels for steelhead are summarized in Table 4-11. All steelhead would be released as smolts and there would be no releases of fry, fingerling, or surplus fish.

Table 4-11 Proposed Annual Steelhead Release Levels by Lifestage and Location

Lifestage	Maximum Number	Size (fish per pound)	Release Date	Release Location
Eyed Eggs	0	NA	NA	NA
Unfed Fry	0	NA	NA	NA
Fry	0	NA	NA	NA
Fingerling	0	NA	NA	NA
Yearling – DCFH	300,000	4	Jan - Apr	Dry Creek (Yoakim Bridge)
Yearling – CVFF	200,000	5	Jan - Apr	East Fork Russian River (CVFF)

Yearling smolt steelhead from DCFH would be released in Dry Creek, 3 miles downstream from the hatchery at Yoakim Bridge. Yearlings from CVFF would be released at the discharge point of the CVFF facility. DCFH releases would be forced, while CVFF releases would be volitional during a 1-month acclimation period, and then forced at the end of the period. Because fish released from the DCFH are spawned, incubated, and reared in the water in which they are released, they would be acclimated for their entire juvenile lifestage. Fish released at CVFF would be transported to the facility from DCFH approximately 30 days before their release. The proposed release sizes for DCFH and CVFF steelhead are a larger size than their naturally-spawned counterparts at the same age.

4.6.3.3 Harvest Management

Current fishing regulations allow the take of hatchery-reared steelhead. (All steelhead released from DCFH and CVFF are marked with clipped adipose fins.) Harvest of naturally-spawned steelhead is prohibited. There are no current estimates of harvest levels of steelhead within the Russian River, but there is indication that funding soon may be available for a project to estimate harvest levels (Royce Gunter, CDFG, pers. comm. January 8, 2002). It is assumed that the existing steelhead harvest practices would be continued under the proposed project, unless the results of monitoring indicate that harvest practices are negatively affecting the naturally-spawned population level.

4.6.3.4 Monitoring and Evaluation

Monitoring and evaluation of critical areas will be conducted to ensure that the steelhead isolated harvest program is operating in a successful manner. Criteria indicating a successful isolated harvest program include:

1. The numbers of adult hatchery-reared steelhead returning to the Russian River basin (including those harvested by recreational fishers) meet or exceed the minimum broodstock spawning numbers plus any established harvest goals.

2. Population assessments indicate a stable or increasing trend in the number of adult steelhead returning to spawn in the Russian River, with measured adult-to-adult replacement greater than or equal to one. This population assessment includes adults of both the hatchery-reared and naturally-spawned components.

3. Population assessments conducted in release streams indicate no change or an increase in abundance of the wild population.

4. Genetic assessments of both the wild and hatchery-reared components conducted over time show no loss or an increase of genetic variation in either component; divergence of the two components are acceptable, depending on the desired level of stock isolation.

Greater detail regarding the biological basis for these criteria can be found in the BRA document (FishPro and ENTRIX, Inc. 2002). Performance indicators, as well as plans proposed for monitoring and evaluation of those indicators, are presented in the draft DCFH steelhead HGMP (FishPro and ENTRIX, Inc. 2003).

4.6.4 COHO SALMON INTEGRATED RECOVERY PROGRAM

The proposed captive broodstock program for coho salmon would have similar objectives to the existing CDFG pilot captive broodstock program. The program would continue to collect naturally-produced juvenile coho salmon, rear the fish to maturity, and use them as broodstock to produce fingerlings. The fingerlings would be released into appropriate streams in the Russian River basin. The objectives of the captive broodstock program are to: 1) prevent extirpation of Russian River coho salmon; 2) preserve genetic, ecological, and behavioral attributes of Russian River coho salmon while minimizing potential effects to other stocks and species; and 3) build a naturally-sustaining coho salmon population. The program serves a secondary purpose of research, providing information on the effective use of artificial propagation to address other goals. Any changes to the existing pilot captive broodstock program will require analysis and approval via amendments to the existing Section 10 permit for the program.

The time-frame necessary to measure and evaluate the objectives is estimated to be a minimum of five salmon generations, so that a statistically significant number of samples can be obtained for analysis. For the captive broodstock program, an additional 4 years of start-up time is necessary to allow for broodstock growth to sexual maturity following the initial capture of adults.

4.6.4.1 Broodstock Selection and Mating

The proposed program calls for the collection of 300 to 600 juvenile coho salmon annually for potential use as broodstock, followed by rearing in captivity until the fish reach maturity. Electrofishing for juvenile coho salmon from selected streams will be conducted between March and November. Procedures for electrofishing will be employed as specified in Permit 1067 (NMFS 2001a). Broodstock would be collected from a random selection of juvenile coho salmon encountered during each electrofishing capture event. To preserve the naturally-reproducing component of the stock, no more than 50 percent of the juvenile fish encountered will be collected.

Determination of the specific streams to be surveyed each year as potential broodstock sources will be developed in consultation with NOAA Fisheries and the Technical Oversight Committee (TOC) as long as it is active. The preferred source for broodstock is within the Russian River basin. Streams identified as possible sources include Green Valley, Purrington, Freezeout, Willow, Ward, Sheephouse, and Felta creeks. If insufficient numbers are obtained after initial collection efforts, additional collection may be conducted if suitable watersheds can be identified. The risks of inbreeding versus outbreeding depression would be carefully weighed before out-of-basin transfer would occur. Collection efforts will be adjusted as genetic information is developed on the relationships between Russian River stocks and populations in other candidate watersheds.

In September 2001, 344 juveniles were collected in the Russian River basin, mostly from Green Valley; 301 of these juveniles were on hand as of July 2003. For the subsequent 2002-year class of captive broodstock, 458 juvenile coho salmon were on hand as of July

2003, collected from Green Valley, Mark West, and Dutch Bill creeks in the Russian River basin. Gender proportions have not yet been determined. Assuming a spawn of 100 females, there will be an egg take of roughly 230,000 for each year class.

The TOC will evaluate the best strategies to increase genetic diversity during the initial captive brood maturation period, and will make a recommendation before the first spawning anticipated in late 2003 or early 2004. State-of-the-art genetic analyses will be conducted for all fish used in the program, and the results of the analyses will be used to dictate the combinations of mature coho salmon to use in the spawning process.

Most coho salmon mature in their third year, but some fish, typically males, will mature a year early. It is possible that some captive brood will mature early, and/or it may be possible to induce precociousness through hormone treatments. The TOC will evaluate the potential benefits of using precocious males to transmit genetic material between year classes, thereby increasing genetic diversity and/or supplementing weak year classes. The TOC will evaluate the feasibility of cryopreservation of milt and the cost of associated equipment and implementation, and provide the findings in the first annual report for the program.

4.6.4.2 Rearing and Release

As of July 2003, the fish on hand for the coho salmon recovery program were introduced into newly constructed facilities at DCFH. The facilities include six intermediate juvenile rearing troughs measuring 16 feet long by 3 feet wide with a 2.5-foot water depth. Also included for the broodstock are six circular tanks, 20 feet in diameter with a 4.5-foot water depth. An additional expansion is planned for 2004 to double the number of troughs and tanks and provide a building enclosure for the area.

Rearing-pond densities for the captive broodstock will be managed so they do not exceed a maximum density of 0.5 pound of fish per cubic foot of space (lb/ft^3). Rearing-pond densities for fish to be released will be held at low densities so they do not exceed 1.5 lb/ft^3. Lower densities will be maintained whenever possible. Fish will be reared to a target-release size that mimics the size of natural fish of the same age, to minimize the risk of predation and competition with natural fish upon release. Table 4-12 summarizes the annual fish-release levels and locations for coho salmon currently proposed by the TOC.

Table 4-12 Proposed Annual Coho Release Levels by Lifestage and Location

Lifestage	Maximum Number	Size (fish per pound)	Release Date	Release Location
Eyed Eggs	0	NA	NA	NA
Unfed Fry	0	NA	NA	NA
Fry	0	NA	NA	NA
Fingerling (advanced size)	100,000 (20,000 each stream)	60	Oct-Nov	5 streams: Willow, Sheephouse, Freezeout, Mill, Ward
Yearling	0	NA	NA	NA

These release levels and locations are being discussed and may evolve further. Additionally, the TOC will make recommendations to NOAA Fisheries regarding disposition of any excess eggs, fry, fingerlings, or smolts beyond the current goal of releasing 100,000 advanced fingerling.

All coho salmon released as part of the coho salmon recovery program will be tagged. Tagging options are currently being discussed by the TOC, including coded wire tags, adipose fin clips, visible implant elastomer markers, and passive integrated transponder tags. Decision-making factors include cost and funding; size at release; and desired level of information regarding parent lineage, stocking stream groups, and year class.

All juvenile fish collected as part of future broodstock collection efforts will be assayed with scanning equipment as relevant for the types of tags used on released fish. Any tagged coho salmon that are captured will be released back to their capture location.

4.6.4.3 Monitoring and Evaluation

Monitoring and evaluation of critical areas will be conducted to ensure that the coho salmon integrated recovery program is operating in a successful manner. Criteria indicating a successful integrated recovery program include:

1. Population assessments indicating an increasing trend in the number of adult coho salmon returning to the Russian River, with measured adult-to-adult replacement greater than or equal to one.

2. Population assessments conducted in release streams indicating no change or an increase in abundance of the naturally-spawning component.

3. Genetic assessments of both the naturally-spawning and hatchery-reared components conducted over time, showing no loss or an increase of genetic variation in each component.

Performance indicators, as well as plans proposed for monitoring and evaluation of those performance indicators, are presented in the DCFH coho salmon HGMP (FishPro and ENTRIX, Inc. 2003).

A long-term comprehensive monitoring program for stream condition and adult and juvenile abundance is being developed by the capture, release, and monitoring subcommittee of the Russian River Coho Salmon Recovery Workgroup.

4.6.5 Facility Changes

Existing hatchery facilities and proposed modifications to DCFH are described in detail in the draft HGMPs for steelhead and coho salmon. This section summarizes proposed water supply modifications that will enhance both the steelhead and coho salmon programs conducted at DCFH.

4.6.5.1 Water Supply Modification

The total DCFH water demand for the fish production aspects of the baseline mitigation program is 25 cfs. When broodstock collection and holding operations are also occurring, the demand increases to approximately 35 cfs to operate the fish ladder and maintain the captured fish in the holding ponds. Currently, water for the hatchery is taken from the outlet works of the stilling basin of Warm Springs Dam. An emergency water supply is used to supply a sufficient quantity of water to the hatchery when the outlet works and power plant are not operating.

A new water supply would be constructed for the DCFH that would tap into the existing wet well and provide a single pipeline capable of delivering 50 cfs of gravity-flow reservoir water to the DCFH facilities. The new water supply will eliminate the need for the emergency water supply system, and the existing emergency supply pipeline would be removed. A feasibility study to determine the best design option is planned for 2004, with possible construction occurring in 2007 or later.

4.6.6 Future Supplementation Programs

As part of the regulatory framework provided by ESA, NOAA Fisheries has established nine domains spanning the geographic range of listed West Coast salmon and steelhead, with the intent of developing comprehensive recovery plans for all listed ESUs within each domain. The Russian River is located within the North-Central California Coast domain. Some of the initial efforts that will be completed through the recovery planning process are: 1) an evaluation of the current status of the listed population or species; 2) an assessment of the factors affecting the species; and 3) an identification of recovery (delisting) goals. As new information on the status of Russian River populations becomes available from the recovery planning, it may become appropriate to use the DCFH and CVFF to support recovery efforts differently than the programs proposed in the previous section.

As previously described, the recommended hatchery programs under the proposed project include: 1) an isolated harvest program for steelhead; 2) a supplementation program for coho salmon; and 3) “no production” for Chinook salmon. If new information indicates it is warranted, alternative hatchery production programs for each of the three listed species may be implemented. The programs would be formulated to have the least possible effect on the wild populations for each of the three listed species, given the current understanding of each species’ population and genetic characteristics.

The use of hatcheries to supplement wild stocks is a controversial topic, in part due to confusion over the definition of the term. NOAA Fisheries (Flagg et al. 2000) suggests the most practical definition may be:

> *Supplementation is the stocking of fish into natural habitat to increase abundance of naturally reproducing fish populations.*

NOAA Fisheries has recommended that supplementation of a population may be appropriate if (Flagg et al. 2000):

- The wild population is declining.
- Sufficient spawning habitat is available and underused.
- Other actions that could address the cause(s) of population declines cannot be implemented in a timely manner.
- Hatchery technology and facilities are available to increase stock productivity above replacement.

The DCFH and CVFF provide a rare opportunity for rapid implementation of a supplementation program, should the conditions described above be found to exist for steelhead or Chinook salmon in the Russian River. A proposed program for steelhead production, referred to as an integrated harvest, is presented below. This program for steelhead differs from the isolated harvest program described above, primarily in the use of wild steelhead broodstock rather than returning hatchery-reared fish, thus reducing the risk of genetic effects to the wild population. The implementation of this program assumes that the wild steelhead population is stable or increasing, which again is dependent on the results of population studies likely to be completed through recovery planning efforts. In addition, a Chinook salmon supplementation program is described and analyzed, in case future data show the Russian River Chinook salmon population to be below the viable population threshold. (Coho salmon are not considered in this analysis because the proposed coho salmon program presented in the BA consists of supplementation.)

4.6.6.1 Steelhead Integrated Harvest Program

Program Objectives

The proposed future integrated harvest program for steelhead would meet the objectives of the existing steelhead enhancement program, except that wild steelhead trout would be used as broodstock to eliminate genetic differences between the hatchery-reared and naturally-spawning components. Additionally, the integrated harvest program would include a supplementation component to compensate for the numbers of broodstock collected from the wild, as well as to increase the population of naturally-spawning steelhead. The objectives of the integrated harvest enhancement program are to:
1) provide a fishery for hatchery-reared steelhead in the Russian River basin;
2) contribute to the naturally-spawning steelhead population at a level greater than the level of broodstock collection from the wild; and 3) preserve genetic, ecological, and behavioral attributes of wild Russian River steelhead while minimizing potential effects to other stocks and species.

Criteria for evaluating success of the integrated harvest program involve measurement of the following critical areas:

- The numbers of adult hatchery-reared steelhead returning to the Russian River basin (including those harvested by recreational fishers) meet or exceed the escapement goals.

- Population assessments indicate an increasing trend in the number of adult steelhead returning to the Russian River, with measured adult-to-adult replacement greater than or equal to one. This population assessment would include adults of both the hatchery-reared and naturally-spawned components, because presumably there would be no genetic difference between the two components.

- Population assessments conducted in release streams indicate no change or an increase in abundance of the naturally-spawning component.

- Genetic assessments of both the naturally-spawning and hatchery-reared components conducted over time show no loss or an increase of genetic variation in each component.

Estimated Time-Frame to Achieve Objectives

The time-frame necessary to measure and evaluate the objectives of a steelhead integrated harvest program is estimated to be 17 years. This includes a period of three generations, so that a statistically significant number of samples could be obtained for analysis. Assuming 5 years to be the average length of a steelhead generation, the period of three generations is 15 years. An additional 2 years of start-up time is necessary to allow for the first cycle of adult collection and fingerling production.

Program Description

The steelhead supplementation program recommended for the Russian River basin would consist of the following components:

- Wild adult steelhead would be collected at a location downstream of the supplementation stream-release location. A broodstock collection goal of 269 wild adult steelhead has been established based on consideration of several factors including minimum effective population size, estimated productivity of the wild population, and estimated smolt-to-adult return rate for the hatchery population (Table 4-13). It is assumed that an adult trapping, sorting, and collection facility would be developed at a suitable location before implementation of the supplementation program. (Wild broodstock collection at the existing DCFH and CVFF traps is not feasible because there is no spawning habitat upstream of the traps, and thus no measures for attracting wild fish into the traps.)

- The wild steelhead broodstock would be transported to existing holding facilities at DCFH and would be spawned there when ripe. The same site would be used to provide incubation of 638,500 eggs and rearing facilities for 500,000 pre-smolt fingerling. Though these fish are the progeny of wild broodstock, all fish will be marked with a coded wire tag or similar unique marker to identify them as hatchery-reared fish.

Table 4-13 Steelhead Integrated Harvest Program: Assumed Conditions and Facility Production Guidelines

	DCFH	CVFF	Supplementation Streams
Minimum number broodstock collected	161	108	NA
Spawning male:female ratio	1:1	1:1	NA
Pre-spawning survival	95%	95%	NA
Females spawned	77	51	NA
Fecundity	5,000	5,000	NA
Total egg take	383,100	255,400	NA
Survival – egg take to fry ponding	87%	87%	NA
Total fry ponded	333,300	222,200	NA
Survival – ponding to smolt release	90%	90%	NA
Total F_1 smolt released or transferred	300,000	200,000	NA
On-site releases	230,000	200,000	70,000
Supplementation stream transfers	70,000	0	0
Size at smolt release	6.8 inches	6.8 inches	6.8 inches
Period of smolt release	Jan-Apr	Jan-Apr	Jan-Apr
Survival – smolt release to adult return	1.0%	1.0%	1.0%
F_1 adults returning (before harvest)	2,300	2,000	700
Estimated harvest (15%)	345	300	105
Broodstock reserve (use F_2 if available)	161	108	0
Fish passed for natural spawning	0	0	595
Est. productivity of naturally-spawned pop.	NA	NA	0.5
Estimated wild (F_2) adult return	NA	NA	298
Target F_2 broodstock collection	NA	NA	269

- Smolts would be released from at least three locations. A total of 200,000 smolts would be released into the East Fork Russian River through volitional release from CVFF following a 1-month acclimation period (as with the existing isolated harvest program). Another 230,000 smolts would be released directly into Dry Creek from DCFH. The final 70,000 smolts would be used to supplement the naturally-spawning population by releasing the fish into one or more selected streams having total available spawning capacity for approximately 700 steelhead adults. As hatchery-reared fish, all adults returning from these smolt releases will be subject to harvest. However, assuming a harvest rate of 15 percent, approximately 595 fish would return to the supplementation streams, thereby providing sufficient numbers of naturally-spawning broodstock to produce wild steelhead progeny (i.e., the F_2 generation) that can, in turn, serve as wild broodstock for the integrated harvest program without concern for genetic effects. (F_x refers to generations removed from the parental generation. F_1 refers to the progeny of a given parental cross, F_2 refers to the offspring of those progeny. For example, F_1 refers to children and F_2 refers to grandchildren.)

- An annual monitoring and evaluation plan will be implemented to evaluate, at a minimum: 1) the population abundance of both hatchery-reared and naturally-spawned adults returning to the Russian River, as measured at the adult collection facility; 2) the population abundance of the specific release streams; and 3) a genetic assessment of both the naturally-spawning and hatchery-reared components conducted over time to assure no loss of genetic variation in each component. Additional monitoring parameters are recommended in the HGMP.

4.6.6.2 Chinook Salmon Supplementation Program

Program Objectives

The Chinook salmon supplementation program would collect wild returning adult Chinook salmon and use them as broodstock to produce fingerlings in the hatchery. The fingerlings would be subsequently seeded into appropriate streams in the Russian River basin. The objectives of the supplementation program are to: 1) prevent extirpation of Russian River Chinook salmon; 2) preserve genetic, ecological, and behavioral attributes of Russian River Chinook salmon while minimizing potential effects to other stocks and species; and 3) build a naturally-sustaining Chinook salmon population.

Criteria for evaluating success of the supplementation program are:

- Population assessments indicate an increasing trend in the number of adult Chinook salmon returning to the Russian River, with measured adult-to-adult replacement greater than or equal to one. This population assessment would include adults of both the hatchery-reared and naturally-spawned components, because presumably there would be no genetic difference between the two components.

- Population assessments conducted in release streams indicate no change or an increase in abundance of the naturally-spawning component.

- Genetic assessments of both the naturally-spawning and hatchery-reared components conducted over time show no loss or an increase of genetic variation in each component.

Estimated Time-Frame to Achieve Objectives

The time-frame necessary to measure and evaluate the objectives of a Chinook salmon supplementation program is estimated to be 17 years. This includes a period of five generations, so that a statistically significant number of samples could be obtained for analysis. Assuming 3 years to be the average length of a Chinook salmon generation, the period of five generations is 15 years. An additional 2 years of start-up time is necessary to allow for the first cycle of adult collection and fingerling production. A secondary factor in selecting program duration is an assumption that habitat restoration efforts within the Russian River may require 10 to 20 years.

Program Description

The Chinook salmon supplementation program recommended for the Russian River basin consists of the following components:

- Wild adult Chinook salmon will be collected at a location downstream of the supplementation stream release location. A broodstock collection goal of 242 wild adult Chinook salmon has been established, based on consideration of several factors including minimum effective population size, estimated productivity of the wild population, and estimated smolt-to-adult return rate for the hatchery population (Table 4-14). It is assumed that an adult trapping, sorting, and collection facility would be developed at a suitable location before implementation of the supplementation program; conceivably, this collection facility could be developed at Mirabel dam. (Wild broodstock collection at the existing DCFH and CVFF traps is not feasible because there is no spawning habitat upstream of the traps, and thus no measures for attracting wild fish into the traps.)

- The wild Chinook salmon broodstock will be transported to existing holding facilities at DCFH and will be spawned there when ripe. The same site will be used to provide incubation of 460,000 eggs and rearing facilities for 360,000 fingerling smolts. All fish will be marked with a coded wire tag or similar unique identifier prior to release.

- The 360,000 fingerling smolts will be released into one or more selected streams having total available spawning capacity for at least 478 Chinook salmon adults.

Table 4-14 Chinook Salmon Supplementation Program: Assumed Conditions and Facility Production Guidelines

Target number wild broodstock	242
Spawning male:female ratio	1:1
Pre-spawning survival	95%
Females spawned	115
Fecundity	4,000
Total egg take	459,800
Survival – egg take to fry ponding	87%
Total fry ponded	400,000
Survival – ponding to smolt release	90%
Total F_1 smolt released	360,000
Size at smolt release	3.6 inches
Period of smolt release	Mar-May
Survival – smolt release to adult return	0.20%
F_1 adults returning	720
Broodstock reserve (prefer F_2)	242
Fish passed for natural spawning	478
Est. productivity of naturally-spawned pop.	0.5
Estimated wild (F_2) adult return	239
Target F_2 broodstock collection	242

- An annual monitoring and evaluation plan will be implemented to evaluate, at a minimum: 1) the population abundance of both hatchery-reared and naturally-spawned adults returning to the Russian River, as measured at the adult collection facility; 2) the population abundance of the specific release streams; and 3) a genetic assessment of both the naturally-spawning and hatchery-reared components conducted over time to assure no loss of genetic variation in each component.

4.7 REQUIRED CHANGES TO INSTITUTIONAL AGREEMENTS AND CONSTRAINTS

To implement the proposed changes and modifications to the facilities and operations described in the preceding sections, several of the existing Institutional Agreements and Constraints described in Section 1.4 will require revision. This section identifies and briefly describes the required changes.

4.7.1 SWRCB DECISION 1610

D1610 and SCWA's water-rights permits specify the existing minimum flow requirements for Dry Creek and the Russian River (Section 1.4.3). SCWA's permits will need to be amended so that the Flow Proposal and Estuary management protocols as described in Section 4.3 may be implemented.

4.7.2 WARM SPRINGS DAM HYDROELECTRIC FACILITY

The FERC license granted to SCWA for the Warm Springs Dam hydroelectric facility that incorporated the D1610 minimum flow requirements (Section 1.4.2.2). Because proposed Dry Creek flows will be less that the D1610 minimums that were incorporated into the FERC license, amendment of the FERC license will be required.

Under SCWA's power sale contract with PG&E, SCWA receives "capacity" payments from PG&E in addition to payments for power actually delivered. The capacity payments are based upon a "firm capacity" of 1.246 megawatts during the summer months. Because the hydroelectric turbines at Warm Springs Dam cannot be operated at flows less that 70 cfs, SCWA would be not be able to provide the "firm capacity" contemplated by the power sale agreement with PG&E. This will result in reduced revenue to SCWA and the possible de-rating of the capacity of the Warm Springs Dam hydroelectric facility. The contract expires in 2006.

4.7.3 FLOW BYPASS FOR COYOTE VALLEY DAM

In order to provide bypass flows during dam inspections, the USACE will need to install pumps and a pipeline to deliver the water from Lake Mendocino to East Fork Russian River (described in Section 4.1). Installation of the bypass system at Coyote Valley Dam would require congressional approval and funding.

4.7.4 USACE CHANNEL MAINTENANCE REQUIREMENTS

The channel maintenance requirements of the USACE are inconsistent with the channel maintenance procedures proposed in Section 4.4. The USACE would need to revise their channel maintenance requirements to reflect the implementation of focused channel maintenance and vegetation clearing activities that provide greater protection for listed fish species. The existing O&M manuals for the CVDP and WSDP were authorized by Congress.

4.7.5 FISH PRODUCTION FACILITIES

The current mitigation goals established for the fish production facilities for coho and Chinook salmon are inconsistent with the proposed operations of the fish facilities in Section 4.6. Steelhead production will maintain existing mitigation goals. The existing mitigation and enhancement goals for coho will be put on hold for the duration of the coho salmon recovery program, which is currently scheduled to expire in 2007. The existing mitigation and enhancement goals for Chinook salmon will be put on hold and there will be no Chinook salmon production, unless directed otherwise by NOAA Fisheries and CDFG. A formal revision of the mitigation and enhancement obligations for USACE for coho salmon, steelhead, and Chinook salmon will be completed when the USACE, NOAA Fisheries, and CDFG determine new goals that would be consistent with recovery plans and make the best use of fish production facilities and operations.